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PAG Bulletin

FAO/WHO/UNICEF Protein Advisory Group
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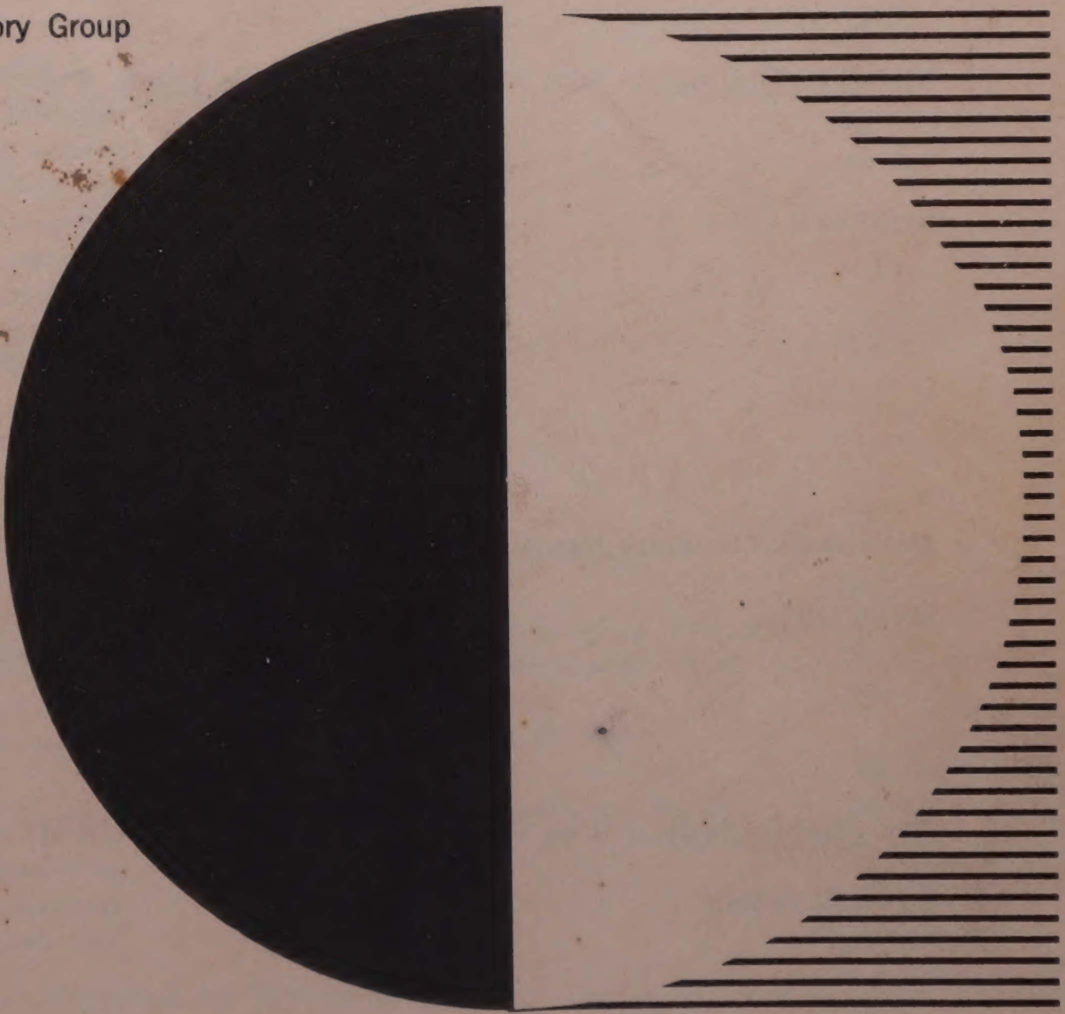

Food and Agriculture
Organization
of the United Nations
Rome

World Health Organization
Geneva

United Nations Childrens Fund
New York

International review of action to improve world protein nutrition

ABOUT THE PAG BULLETIN

PURPOSE

The PAG Bulletin is published by FAO/WHO/UNICEF Protein Advisory Group. Its purpose is to give information on the world protein problem to those individuals, academic institutions, and industrial organizations who are interested in helping solve the protein problem, and to promote the exchange of information in this field.

MAILING LIST

The PAG Bulletin is sent without charge to persons, organizations and companies with an active interest in proteins. The present list comprises 2,000 names, about half in the U. S. A. and half well-distributed through the rest of the world. Requests to be added to the mailing list for the PAG Bulletin should be addressed to the Secretary, FAO/WHO/UNICEF Protein Advisory Group, United Nations, N. Y. 10017, U. S. A.

QUOTING

Permission to quote items from the PAG Bulletin is not required except from authors of signed articles. The Secretariat of the PAG will appreciate being informed of quotations that are made from the PAG Bulletin.

SUGGESTIONS

The PAG Bulletin will be successful only if it reflects all aspects of the protein problem comprehensively and objectively. The Secretariat invites suggestions and ideas for broadening and deepening the scope of the PAG Bulletin.

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SEVENTEENTH MEETING OF PAG, NEW YORK, MAY 1970

The meeting covered a very wide range of topics. For example, the PAG considered ways and means of assisting governments in formulating a food and nutrition policy, research areas of broad interest to developing countries and the need for documentation in the edible protein field. The Group commented on the efforts being made by various United Nations bodies to bridge the "protein gap". Specific subjects such as leaf protein concentrate and nutrition and food use objectives in plant breeding were also discussed. A number of "Guidelines" and "Statements" were approved.

The PAG held its 17th session at the headquarters of UNICEF in New York, N.Y., U.S.A., 25 - 28 May 1970. Two of the members, Professor A. A. Pokrovsky and Dr. H. Mitsuda, were not able to attend.

Several representatives from the sponsoring agencies, FAO, WHO and UNICEF, participaed as well as a representative of Unesco, which is a full participating Member Agency. Represented also were the following:

- The United Nations Advisory Committee on the Application of Science and Technology to Development (ACAST)
- The United Nations Office of Science and Technology
- The United Nations Regional and Community Development Section
- The Joint FAO/IAEA Division of Atomic Energy in Food and Agriculture
- The United Nations Industrial Development Organization (UNIDO)
- The International Bank for Reconstruction and Development (IBRD)
- The United Nations Development Programme (UNDP)
- The World Food Programme (WFP)
- The Pan-American Health Organization (PAHO)

Several advisers to the PAG attended the meeting for different lengths of time. The total number of participants was fifty-one.

Opening statement

The meeting was opened by Mr. Henry R. Labouisse, Director, UNICEF, who welcomed the participants, especially the two new members of the PAG, Professor L. Einsiedel and Dr. N. H. Neyzi. Mr. Labouisse summarized UNICEF's activities in the protein field where special attention is being given to centrally-processed weaning foods, such as Superamine. The recent meeting of the Board of UNICEF approved the high priority that nutrition should have in the work of UNICEF.

The FAO provisional Indicative World Plan for Agricultural Development

The provisional Indicative World Plan for Agricultural Development is an effort to analyze the major issues which will confront world agriculture in the 1970s and early 1980s and to suggest the most important directions for national and international action to resolve them. The Plan sets 1975 and 1985 as target dates for the objectives it proposes.

The FAO produced the Plan on instructions given from its Member Nations in 1965, after the idea was suggested by the first World Food Congress in Washington in 1963.

The Group reviewed the Plan, and noted with satisfaction that nutrition has received a great deal of attention. The PAG emphasized that the average figures given in the Plan should not lead to the conclusion that the protein gap can be easily bridged. There are many inequalities in protein supply and distribution within a population. Even when supplies are 20 percent above the average national requirements, a significant part of the population may not have its requirements satisfied. Although family intake of protein appears to be adequate, protein malnutrition may still occur. This is because individual family members who have special needs, such as the preschool children and the pregnant and lactating women, do not necessarily receive a share proportional to their needs. The projection of the future supply and demand situation in the Indicative World Plan is on the basis of 1962 prices. The limitations introduced by this assumption are of course well recognized by the planners. It is likely that protein food prices, especially for animal products, will rise considerably in many countries as compared to the increase in prices for other foods. Protein foods will, therefore, be even more outside the reach of the underprivileged groups unless national food and nutrition policies succeed in protecting these groups.

The Group prepared a new statement on the nature and magnitude of the protein problem (PAG Statement No. 3) on the basis of the information in the Plan and along the lines mentioned above. Also, the PAG prepared a comment on the Indicative World Plan to be used at the Second World Food Congress.

A systems approach to the protein problem

The original report by ACAST to the Economic and Social Council (ECOSOC), "International Action to Avert the Impending Protein Crisis" called for a systems approach to the edible protein field. The proposal was reiterated in the Secretary-General´s Report on the Protein Problem in 1968 and has since been endorsed in PAG´s comments on that report.

The term "systems analysis" is used to mean the specification and systematic analysis of alternatives in solving a given problem. In the systems approach, a specific problem is studied within a larger context so that interrelationships between different parts of the system can be taken into account. In other words, a systems approach is an aid to decision-making in a systematic way. The proposal can be considered an attempt to apply this interdisciplinary technique at national and regional levels to the protein problem confronting the developing countries.

The Secretariat had obtained two documents for the meeting; one by Mr. Levinson and Dr. Call (PAG document 1.13/1) and one prepared by Battelle Memorial Institute, Columbus, Ohio, U.S.A. (PAG document 1.13/2). Dr. S. M. Cantor and his associates made available for the meeting a paper presented at an International Conference on Amino Acid Fortification of Protein Foods at Massachusetts Institute of Technology, Cambridge, Mass., U.S.A., September 1969.

Since existing nutrition intervention programmes often tend to be uncoordinated approaches initiated without sufficient analysis of the overall costs and benefits, PAG agreed with ACAST that the concept of a systems approach and the evaluation of alternate strategies for nutritional improvement should guide programme development. On the other hand, the understanding of this approach is not widespread and available data are inadequate for the quantitative application of sophisticated models.

The PAG felt that at the moment it would be most useful to carry out a number of case studies in selected countries. The studies should focus on collection of the kinds of data necessary for the utilization of this type of analysis.

The PAG prepared an interim document (PAG Statement No. 10) which is designed to inform governments and decision-makers in common language what a systems approach is.

Ways and means of assisting governments

At its 15th meeting the PAG discussed the need for more coordinated action on the national level and the Group stated in its comments on the Secretary-General´s Report on the Protein Problem (E/4592) the desirability of government´s establishing collaboration among departments and with scientists, technologists, and businessmen. Such cooperation should be permanent and effective. In Resolution 2416 (XXIII) the General Assembly called for an integrated approach on the national level. It was with this background that the subject was placed on the agenda.

It was introduced by Mr. Alan Berg. As a useful background for his presentation he referred to the discussion on the systems approach under agenda item 4 and especially to the paper by Levinson and Call. Mr. Berg presented a case study, taking India as an example (PAG document 1.17/1). He described the means used in India to bring nutrition policy from a form of humanity or welfare into a position of economic significance in the national budget.

Food is not a mere means of survival, but is essential for a purposeful, constructive, creative and enjoyable life. Nor is food "final consumption"; it is an investment in human resources. Food is necessary for good health and it is most likely also important for learning capacity. As an example, it was mentioned that developing countries spend a considerable proportion of their GNP on children who if ill-fed will never reach an age at which they can be productive workers. These expenses are net losses, quite apart from the human suffering involved.

Through sound food and nutrition policies it may be possible to reach self-sufficiency in foods, to raise the GNP and to promote exports with much greater speed and efficiency than through other development programmes.

The PAG prepared a statement along these lines. (PAG Statement No. 13.)

Comments on United Nations considerations in the field of edible protein

The following organizations in the United Nations system had made available to the PAG reports or notes on efforts being made to bridge the protein gap: ECAFE, ECLA, FAO, IAEA, IBRD, UNDP, Unesco, UNICEF, UNIDO and WHO.

Efforts ranged from marked reorientation of activities backed up with suitable allocation of funds and increased education, training and research activities to inter- and intra-agency considerations as to the seriousness of the problem and possible contributions that may be made.

The PAG recognized the leadership role that the Agencies sponsoring the PAG plan in this field and appreciated the beginning that had been made by other United Nations groups.

The PAG discussed the draft report "Commentary on the World Protein Situation" prepared by Professor F. Aylward, The University of Reading, England, for the PAG Secretariat as a report to ACAST by the sponsoring Agencies on behalf of the PAG. The Group recommended that the draft version should be made available to ECOSOC to serve as a background paper to the Secretary-General's Progress Report on the Protein Problem (E/4829). Also, it recommended that the final version be published in some form suitable for much wider distribution and possibly for use in education.

The PAG expressed its appreciation of the activities of ACAST, which has shown increased awareness of and concern for the problem of protein malnutrition by the United Nations and its Agencies and among nations and recommended that the ACAST continue as the body to carry out this function.

Leaf protein concentrate

This agenda item represented an instance of a problem being referred to the PAG directly from a government.

The PAG had received a request from the United Kingdom Ministry of Overseas Development to express its views on leaf protein concentrate (LPC) manufactured by what is known as the Pirie process. The inquiry included a report on the present stage of LPC and the Secretariat had also obtained comments on the inquiry from various centres which are engaged in work in this field.

The PAG did not feel it appropriate to give a simple recommendation for or against further work on LPC. It noted the good properties of leaf protein: the good biological value, the vitamin A content, the several forms which the product can take, the many sources from which it can be prepared, and the possibility of integrating production with the preparation of other products as a means of cutting costs. On the other hand, the Group drew attention to important disadvantages: its colour, flavour and lack of stability in the less-processed form and its lack of competitiveness in its bland stable powder form in comparison with oilseed protein concentrates. The PAG felt that the balance of expert opinion was that the idea of small-scale village production of the crude leaf protein product was impractical. As in the case of single cell protein and fish protein concentrate the Group saw the possibility that leaf protein might be considered initially as an animal feed supplement.

The PAG concluded that at this stage, in view of the large amount of work already done and in hand, it could not accord further work high priority or recommend the application of aid funds.

Specific subjects submitted by United Nations Agencies

FAO had submitted a summary report on "Feasibility Study for the Development, Production and Distribution of Protein Food Mixtures in the Caribbean Territories". The report was presented to PAG only in order to obtain its comment and guidance. The report is not a PAG document, but was for use at the meeting only. The Group considered the summary report a valuable contribution to a tentative solution of the protein problem in a specific region.

UNICEF had submitted a report "U. A.R. Protein-Rich Weaning Foods Project" to the PAG for information and comments. The report gives the history of development of this typical project over a period of four years, to its present stage, with FAO, WHO and UNICEF involvement. The PAG found this a sound and appropriate example of planning by the United Nations Agencies when assisting governments to initiate and carry forward protein-rich weaning food programmes.

The "Protein Problems in Tanzania" was also submitted by UNICEF. The PAG stressed that Tanzania is an example of a country where the trend in overall production of protein, from vegetable and animal sources taken together, is encouraging. Nevertheless, protein malnutrition is rampant in certain vulnerable groups, especially among children under five years old. The Group noted with satisfaction that the Tanzanian Government gives high priority to the initiation of a programme for industrial production of low-cost protein-rich weaning foods and to the establishment of a national food science and human nutrition institute. The PAG recommended that the United Nations Agencies give particular priority to the following areas: education at all levels; research on oilseed to develop a suitable enrichment of cassava; production of weaning foods based on local cereals; and programmes for pest, insect and product control to preserve the harvest.

UNICEF also submitted a report on "Nutrition Problems and Prospects in Java". Because of the extremely low economic level of the people and the limited resources of the Indonesian Government, the PAG noted that measures for nutritional improvement in Java must be unsophisticated and applicable at the local level. It also noted with concern the declining trend in production of soybeans and peanuts and the very low supplies of animal protein. In view of these factors, the PAG considered that the United Nations Agencies should give an unusually high priority to feasible sources of protein, especially for preschool children and pregnant and lactating women.

Research areas of broad interest to many developing countries

On the basis of "Commentary on the World Protein Situation", the Indicative World Plan and PAG *ad hoc* Working Group deliberations, a list (PAG Statement No. 12) was prepared identifying research areas of major world interest in the protein food field. The list was not intended to give an indication of priority of present research efforts.

Many of the areas referred to in the list are affected by the common problem of the transfer of knowledge to the points in developing countries where it is needed. Thus it will be necessary to study the obstacles in the way of this transfer and to try to find ways of overcoming them.

The international Agencies can play a major role in coordinating the research potential of both the more and the less developed countries and in focusing attention on the major issues of the protein problem.

Nutrition and food use objectives of plant breeding

In plant breeding, the objective of nutritional improvement has been less clear than that of higher yields. To give the plant breeders a guideline on what to look for, the PAG at its 16th Meeting adopted a statement on plant improvement by genetic means. For this meeting two documents were available, written by Dr. M. Milner (Document 1.16/3) and Professor V. R. Young(Document 1.16/4).

A supplement to the previous statement was approved by the Group (PAG Statement No. 8). It recommends that nutritional considerations in plant breeding include analysis for protein content and for first- and second- limiting amino acids, permitting prediction of protein nutritive value. Suitable biological assays such as PER and NPU should be checked as early as possible, and processing characteristics and consumer acceptance also have to be taken into account to avoid propagation of unsuitable lines.

Improvement by genetic means is often accompanied by elimination of genetic material which could be useful under future circumstances. Even though technology can often correct undesirable characteristics, a gene bank should be maintained.

Single cell protein

The ad hoc Working Group on Single Cell Protein (SCP) met in Marseilles 8 - 10 April 1970 under the chairmanship of Professor P. A. Pokrovsky.

The Working Group had prepared a statement on various aspects of SCP. The statement was approved by the PAG (PAG Statement No. 4).

The Group recommended that the Secretariat prepare a guideline on SCP.

The Working Group will meet next in June 1971.

Feeding the preschool child

The ad hoc Working Group on Feeding the Pre-school Child met in Geneva 15-18 December 1969. The report from that meeting was presented by Professor B. Vahlquist, Chairman of the Working Group. He emphasized the need to deal with the increasing problem of early weaning in developing countries, especially in view of the special needs of the infant in the early months of life and the possible permanent damage from malnutrition to mental, as well as physical, development. There is need for coordinated studies on food consumption by infants and young children, including quantitative determinations of breast-milk intake and the social dynamics of changes in breast-feeding patterns.

The PAG agreed that more data on food consumption by preschool children are needed and maternal nutrition should be given due consideration.

One of the major problems in preschool nutrition programmes is the difficulty of reaching the pertinent groups of children. The PAG felt that even more emphasis should be given to the training of paramedical personnel and to the involvement of nonprofessionals on a large-scale basis. In some countries, such as India, day-care centres and similar institutions provide special opportunity for day-to-day contact with the children and their mothers.

The PAG underlined the need to establish guidelines not only for the composition of weaning foods but also, and this is even more important, for products intended for and advertised as suitable for the rearing of infants below six months of age. Much harm can be done by products which are promoted as "infant foods" and yet do not fulfil minimal standards with respect to content of protein, vitamins, etc.

A proposal to organize small group meetings between leading pediatricians and high-ranking officials of leading baby food industries was made. They would discuss the special problems involved in the promotion of infant foods in areas with low purchasing power and unhygienic living conditions. This proposal met with general approval. For several reasons, such meetings ought to be arranged on a regional basis. As a suitable place for a first meeting of this kind, Latin America was mentioned, possibly in October-November 1970. (The meeting will take place in Bogota, Colombia, 5-6 November 1970).

The next meeting of the Working Group will be 14-18 September 1970 in Geneva.

Marketing

The progress report of the ad hoc Working Group on Marketing was presented by the Chairman, Dr. S. M. Cantor.

It was reported that a draft guideline for marketing of protein-rich foods is being prepared by Professor B. Wickstrom. The ad hoc Working Group will consider this draft at a meeting in the fall of 1970. The Working Group will also consider then the needs for research and training and the suggestion for setting up a centre or centres to collect marketing experience in the field of protein-rich foods.

Amino acid fortification

PAG Statement No. 9, "Amino Acid Fortification of Foods", 9 January 1970, which was conditionally approved at the 16th PAG Meeting, was reviewed together with the report of the second meeting of the PAG ad hoc Working Group on Amino Acid Fortification held in Cambridge, Mass., U.S.A., on 19 September 1969. The PAG approved the minor editorial and substantive changes in the statement which had been recommended by the ad hoc Working Group and the addition of new sections, on "Alternative vehicles for fortification" and "Losses of added amino acids in processing, storage and preparation of foods for consumption", prepared by consultants in accord with recommendations of the ad hoc Working Group.

Since the ad hoc Working Group on Amino Acid Fortification had completed its task of producing a balanced PAG policy statement in this important and controversial area, the PAG considered that the ad hoc Working Group could be dissolved.

The PAG urged that the PAG statement should be kept up-to-date by the addition of references to pertinent new publications and that it be reviewed for updating at subsequent PAG meetings.

New ad hoc Working Groups

The PAG proposed that the Agencies set up new ad hoc Working Groups on the following subjects:

- Research and Development Areas (PAG Statement No. 12)
- World Protein Situation
- Feasibility of Fish Protein Concentrate for Developing Countries

Documentation

The Secretary-General's Report on the Protein Problem in 1968 recommended that the United Nations investigate the feasibility of instituting a system of classifying information pertinent to the protein problem and of insuring its dissemination and use.

In Resolution 2416 (XXIII) the General Assembly recommended evolving new methods and improving present methods used at the international level for the collection, classification, evaluation and dissemination of information on critical aspects of the protein problem.

Following this, the Agencies sponsoring the PAG decided that the PAG Secretariat should conduct a study on what might be called documentation needs in the edible protein field and draft a proposal for meeting these needs.

The Secretariat had obtained the services of Dr. Ming-yu Li, Food Protection and Toxicology Center, University of California, Davis, Calif., U.S.A. In the course of his study, Dr. Li visited Guatemala, Jamaica and India to get some impression of the needs felt in centres where extensive general library and documentation services are not always available. He also visited FAO and WHO and various other advanced documentation centres.

Dr. Li's report concludes that the main obstacles to effective information dissemination are:

1. Cost, especially of the various abstract journals.
2. Difficulties due to language barriers.
3. Lack of time among the persons interested to peruse the pertinent literature.

It appears that a need is felt for better services in the fields of nutrition, food technology, and socioeconomics. The report concludes that it is necessary to create a means of obtaining current awareness; also, to ensure easy retrieval and easy access to retrieved information efforts should be made to solve the language barrier.

The report recommends the following:
1. The creation of an abstract journal which should cover the whole field mentioned above. It could be published monthly and be based on abstracts prepared for Food Science and Technology Abstracts and other existing abstract publications.
2. Conversion of the PAG Bulletin into a quarterly bulletin with summaries in the working languages of the international organizations. It should attempt to present an overview rather than original articles.
3. A referral system to existing relevant translations should be established.
4. A referral system to information should be created.
5. A documentation and information service should be established.

The PAG expressed general sympathy with the proposals of the report, but felt that the means of implementing them and possibly alternative solutions should be explored further and reported to the next meeting of the Group.

Review of some PAG guidelines and statements

Design and execution of field studies. At its 16th meeting in September 1969, the PAG authorized the circulation of a draft "Guidelines for the Design and Execution of Field Studies", PAG Document 2.36/2, to persons with experience in this field. It was intended that comments and suggestions would be utilized in preparing a revised draft for possible adoption at the 17th meeting. However, the comments indicated the need for two documents. One would describe the procedures for feasibility or pilot field studies in which the objective is to determine whether a proposed measure is sufficiently applicable and practical to justify an evaluation of its effectiveness. The second would be a document on the design and execution of carefully controlled field studies to determine the effectiveness of nutrition intervention programmes.

The PAG recommended that these documents be prepared as soon as possible so that they may be widely circulated for critical review well before the next meeting.

In the interim, the present Document 2.36/2 entitled "Suggestions for the Design and Execution of Field Studies to Evaluate Measures for Improving Protein Nutritional Status" should continue to be available to interested persons.

Solvents. The Joint FAO/WHO Expert Committee on Food Additives during its meeting in June 1970 will be preparing specifications and will evaluate the toxicity of the main solvents used for food products, i.e. dichloro-ethane, isopropanol, isobutanol, hexane, heptane and acetone. These data will be used to prepare for the 18th Meeting of the PAG a draft for new guidelines for solvents used in the extraction of oil or fat from edible materials. Until then the present guideline, PAG Document 10/9 may be used.

Aflatoxin assay. It was suggested that a new document on aflatoxin be prepared for consideration at the next meeting. New information on mycotoxins, which may be more harmful than previously realized, should also be obtained. Until a new document is prepared, the old one may be used. (PAG Document 6/2, entitled a revised biological assay for the detection of aflatoxin).

Groundnut and cottonseed protein concentrates The guidelines on groundnut flour and cottonseed flour had been edited to conform to the style now used for such PAG documents. The drafts for these guidelines contained no change in substance.

Some of the PAG members felt that the Group should consider lowering the minimum protein content in edible cottonseed protein concentrate, since it appeared that 50% could not be maintained in some products. It was also suggested that the E. coli count need not be zero. However, a report on microbiological testing is being prepared by a consultant and the Group requested the Secretariat to have the report on this subject ready for the next meeting.

The PAG approved the two edited guidelines, taking note of the deficiencies due to development since they were first approved. (The edited guidelines are available as PAG Guideline No. 2 on groundnut flour and Guideline No. 4 on cottonseed concentrate).

Sesame and sunflower protein concentrate and vegetable protein isolates. The Group asked the Secretariat and the Agencies to prepare guidelines on sesame and sunflower protein concentrates and on vegetable protein isolates.

Protein-rich food mixtures for older infants and young children. The PAG felt it desirable to prepare a guideline on protein-rich food mixtures for older infants and young children, and a draft was prepared during the meeting. The guideline, PAG Guideline No. 8, is reviewed on page 11 of this Bulletin.

Milk substitutes. The Group briefly reviewed the development of milk substitutes and noted that a great deal of activity is underway in this area by governmental agencies, paediatric associations and various research and development organizations. PAG therefore thought it advisable for it to develop nutritional guidelines as well as proper product designation in line with the recommendations of Codex Alimentarius. One of the consequences thereof is that the term "milk substitutes" should be used rather than the term "milk-like products", and the Group's Statement No. 6 was amended accordingly. A draft guideline is to be prepared for the next meeting of the PAG.

Meeting of directors for testing centres

Since 1966, WHO has been engaged in the testing of protein-rich food mixtures developed jointly by FAO, WHO and UNICEF. In March 1970, a meeting of the investigators involved in this programme and of representatives of the international organizations concerned was convened to discuss the results of the tests carried out, the methodology of testing and the guidelines used in the formulation of protein-rich food mixtures. A report of the meeting is available as WHO document - Nutr. /70.5.

Eighteen protein-rich food mixtures have already been tested for acceptability and tolerance at the request of WHO. The majority were readily accepted by children and well tolerated. The protein quality of the products tested was good to excellent.

The participants in that meeting suggested several changes in the "PAG Guideline for Human Testing of Supplementary Food Mixtures", PAG Guideline No. 7. In particular, for acceptability and tolerance tests, they proposed that the number of subjects be increased to thirty and that the duration of the test be at least four weeks; for growth tests and nitrogen balance measurements, they were of the opinion that the subjects should be children in an adequate state of nutrition. The PAG amended its Guideline No. 7 accordingly.

The participants in that meeting had also agreed that it was urgent to develop low-cost infant foods for the increasing number of young infants which are deprived of breast milk soon after birth.

UNICEF development of protein mixtures with reduced dietary bulk

A paper, "Mixtures with Reduced Dietary Bulk" by Dr. M. Milner, UNICEF, (PAG Document 2.19/24), was available as a meeting document.

The PAG noted with interest and approval that practical and economical industrial methods are available, by means of enzyme treatment of starch or by cooking/extrusion technology, for eliminating the bulky character of gruels prepared by ordinary cooking. This provides a significant increase in calorie concentration and in relative protein availability in foods used for child feeding.

PAG reaffirmed its conviction that processed infant weaning foods should contain fat of a nutritionally desirable kind at levels as feasible up to 10%. However, fat at the 10% level may render such products more expensive and introduce problems in product stability (rancidity) which may require more costly packaging. Attention should be given where feasible to the processing of starch-based protein-supplemented weaning foods by one of the above or similar techniques. This will reduce dietary bulk by eliminating or reducing starch gelatinization properties, thus effectively increasing the nutrient concentration of these foods (protein as well as calories) as they are prepared for the feeding of infants and children.

PAG Meetings 1971

The 18th PAG Meeting will take place at the FAO Headquarters in Rome 9 - 13 February 1971. The 19th Meeting is planned for the fall of 1971 at the WHO Headquarters in Geneva. The Group accepted the following topics for these meetings:

- Activities of and strengthening and creation of regional and national centres for research and training.
- Nutritional guidelines for the formulation of standards and regulations for production and use of protein-rich foods and mixtures for infants and young children.
- Influence of processing on quality and biological value of proteins in foods.
- Relationship between protein calorie malnutrition in early childhood and its possible effects on mental development, learning and behaviour.
- Popular participation and community involvement in programmes designed to bridge the protein gap.
- Meat analogues and their potential in developing countries.
- Extended use of fish for food purposes, especially for the vulnerable groups, and advisability of using fish for nonfood purposes.

Meeting documents

The statements and guidelines approved at the meeting and some of the supporting documents for other agenda items are available to interested parties from the PAG Secretariat.

Vernon R. Young:

PROTEIN NUTRITIONAL ASPECTS OF PLANT BREEDING

A summary of a paper prepared for the 17th Meeting of the PAG. It outlines how an evaluation of nutritive value of proteins can be included in plant breeding work.

Cereal grains and legumes provide a significant, if not major, proportion of the daily protein intake of population groups in developing countries. The importance of increasing the protein quality and quantity of these food staples (in addition to a higher crop yield) has been emphasized by both national and international groups concerned with the protein problem.

In plant breeding programmes where the goals were crops of higher yield and better resistance to disease, it was quite obvious what the plant breeders had to look for. There has been much more uncertainty about what to look for in terms of nutritional improvement. Since one can breed for only a limited number of factors, the paper by Dr. Young is meant as a guideline in the selection of these factors.

The paper gives examples of the importance of quality and/or quantity of dietary protein and of the value of plant protein sources in human nutrition. It recommends that nutritional considerations include analysis for protein content and for first- and second-limiting amino acids which will permit the calculation of chemical scores and prediction of protein nutritive value. Promising new varieties should also be checked as soon as possible by suitable biological assays such as PER and NPU.

Young, Vernon R. 1970. Protein nutritional aspects of plant breeding. PAG, United Nations, New York, U.S.A. 11 pp. Mimeographed. PAG Document 1.16/4.

Revised PAG Statement:

PAG STATEMENT ON AMINO ACID FORTIFICATION OF FOODS

The PAG has issued a revised statement regarding amino acid fortification of foods.

The following summarizes a revised PAG document which states that evidence from animal and human studies suggests that improvement in nitrogen retention or growth occurs when either simple experimental diets or mixed diets typical of food intake patterns in certain regions are supplemented with the limiting amino acid(s). Nitrogen balance studies on humans have employed various age groups, including infants and children, and a variety of cereals such as wheat, maize, sorghum, millet and rice as either the sole or main source of protein in the diet. The amino acid supplement was mainly L-lysine. Depending upon the other limiting amino acids in the diet, in a few experiments DL-threonine or tryptophan were used as supplements along with lysine or DL-methionine was used alone. All the studies carried out under controlled conditions have demonstrated increased nitrogen retention when experimental diets, fed at relatively low levels of protein intake or to depleted subjects, are supplemented with the limiting amino acid.

Similarly, results of growth studies in children using diets based on wheat, sorghum or rice supplemented with L-lysine have shown convincingly in some cases and marginally in others that the growth response of children receiving the amino acid supplemented diets was superior to that of the control groups. The investigations are difficult to compare since methodology varied greatly.

Additional studies are required to determine the limiting amino acids in the diets of vulnerable groups in various developing countries. Also, there is a need to establish appropriate standard conditions for the estimation of BV and NPU in human subjects and to obtain additional data on the effect of amino acid fortification using these measures of protein quality in human subjects.

Cereals have received the greatest attention as potential vehicles for amino acid fortification, but a variety of other items in the daily diet might be suitable carriers for fortification. Further studies are required to identify these from the nutritional, technological and commercial points of view.

Amino acids may be lost during processing, storage and preparation of foods. Baking of bread results in some loss of lysine, particularly from the crust. Heating and boiling also lead to some loss. Further studies are required to determine the effects of various types of storage as well as home cooking and processing on amino acids.

From present evidence, there does not appear to be any hazard from excess lysine even at levels far above those used for fortification purposes. Though high intakes of methionine are known to produce toxic effects, methionine can be added at safe levels to foods.

A decision as to fortification of staple foods with amino acids will have to be made on a local basis. The target groups that can be expected to benefit should be identified and the desirability of amino acid fortification should be judged in comparison with alternative approaches to meeting protein needs. Several other nutritional, economic and social considerations have to be taken into account before a decision on fortification is made. The fortification programme should be considered as only supplementary to the country's overall efforts to increase the protein supplies through conventional and nonconventional means. Since amino acid fortification programmes involve significant cost, it is essential to evaluate both their biological and social effects on the community, using well-designed techniques.

PAG. 1970. Amino acid fortification. PAG, United Nations, New York, U.S.A. 20 pp. Mimeographed. PAG Statement No. 9.

New PAG Guideline :

PAG GUIDELINE ON PROTEIN FOOD MIXTURES FOR OLDER INFANTS AND YOUNG CHILDREN

A summary of a PAG Guideline which was adopted at the 17th PAG Meeting in May 1970.

Malnutrition among children between six months and two years of age is a very widespread and serious problem in many subtropical and tropical countries. Children from lower income groups are especially in danger. This calls for marketing of nutritious low-cost mixtures, which can supplement the child's normal diet and which are acceptable to both children and the adults responsible for providing the children's food. Of paramount importance for these products is, however, maintenance of nutritional standards even though this may mean constraints in relation to cost and acceptability.

The present guideline does not give a real formula for a weaning food. This will in each case depend on the locally available vegetable proteins, and it should also be patterned in accordance with the children's diet in the home. The guideline states the levels of proteins, calories, minerals and vitamins which have to be maintained in order to make sure that the minimal needs are covered, even under very unfavourable dietary conditions, when the food mixture is consumed at the recommended level.

The protein, which in general represents the most difficult problem, should be present at a level of at least 20%, assuming an NPU of at least [illegible] but preferably 65 and a PER of at least [illegible] but preferably 2.3. In order to increase the calorie concentration of the mixture, a level of up to 10% fat may be desirable.

PAG. 1970. Guideline on protein food mixtures for older infants and young children. PAG, United Nations, New York, N.Y., U.S.A. 4 pp. Mimeographed. PAG Guideline No. 8.

ASSISTANT PAG SECRETARY APPOINTED

Dr. P.S. Venkatachalam joined the PAG Secretariat as Assistant Secretary in June 1970. He was previously Deputy Director General, Indian Council of Medical Research, New Delhi, India. Prior to that he was Deputy Director, National Institute of Nutrition, Hyderabad, India.

PAG *AD HOC* WORKING GROUPS

When specific subjects need detailed consideration before they are taken up by the PAG, special PAG *ad hoc* Working Groups are established. The PAG has five such Working Groups at present. The membership of these groups is shown on page 48.

Amino acid fortification

A revised PAG Statement on amino acid fortification, PAG Statement No. 9, was approved by the PAG at its 17th Meeting in May 1970 and has been issued. (See page 10). This Working Group has now been dissolved.

Single cell protein

This Working Group drafted a statement which was adopted by the PAG and has been issued as PAG Statement No. 4. The Group plans to meet again in June 1971.

Marketing

The PAG *ad hoc* Working Group on Marketing will meet in Rome in November 1970 to review the manuscript for a marketing guideline. (See page 13). It will also discuss the need for training and research in this field and a proposal for the establishment of a centre, or centres, for collection and analysis of data on marketing experiences in the protein food field.

Feeding the preschool child

The PAG *ad hoc* Working Group on Feeding the Preschool Child met at WHO Headquarters in Geneva, Switzerland, in December 1969 and again in Geneva in September 1970 for further discussions and preparation of a final report. (See page 13).

Fish protein concentrate

The PAG *ad hoc* Working Group on Fish Protein Concentrate (FPC) will consider more specifically the potential of FPC for developing countries. The Group will meet in London in November 1970.

World protein situation

The PAG has suggested that there is a need for a new authoritative and more extensive statement on the world protein situation. The Steering Committee will consider this subject at its next meeting.

PAG GUIDELINES IN PREPARATION

The PAG is presently preparing a number of guidelines related to various protein food subjects. A list of existing PAG Guidelines is given on page 46.

Microbiology and sanitation

The PAG is having a draft for a guideline on microbiological tests and criteria for dry protein-rich foods prepared. It will be drafted by Dr. F. Thatcher, until recently Chief, Microbiology Division, Food and Drug Directorate, Ottawa, Ontario, Canada. Dr. Thatcher will review existing practices for bacteriological tests on dry protein-rich food mixtures and will then prepare a proposal for a guideline.

Sesame flour

The PAG felt that there is a need for a guideline for the composition and preparation of sesame flour. Dr. H. A. B. Parpia of the Central Food Technology Research Institute, Mysore, India, has undertaken to have a draft for such a guideline prepared by that Institute.

Fish protein concentrate

A draft was prepared and presented to the 16th PAG Meeting in September 1969 for requirements which might be proposed as regards the composition of fish protein concentrate (FPC) (PAG Document 2.8/28). It has been submitted to various specialists for comments and many suggestions have been received. The Fishery Department with the Nutrition Division of FAO is preparing a revision of the draft for consideration at the 18th PAG Meeting in February 1971.

Milk substitutes

The PAG has issued a statement, PAG Statement No. 6, on Milk Substitutes. It indicates that there is a place for such products and also, that they should be clearly labelled and nutritious. The PAG at its 17th Meeting in May 1970 considered that it would be useful to have a guideline outlining what requirements should be made in order that these products can be accepted as nutritious and clearly labelled. The Central Food Technology Research Institute in Mysore, India, has undertaken to prepare a draft for such a document.

Field tests

The PAG at its 16th Meeting in Geneva, 1969, and at its 17th Meeting in New York in May 1970, stated that there is a need for guidelines for the execution of field tests. These may include (I) pilot studies that will determine if a product or programme is feasible; if it is found feasible then (II) an in-depth study may be conducted. Dr. J. E. Gordon of the Department of Nutrition and Food Science, Massachusetts Institute of Technology, Cambridge, Mass., U. S. A., has undertaken to prepare drafts for such guidelines.

Protein isolates

The PAG Steering Committee considered it desirable to develop guidelines for the preparation and composition of protein isolates. Dr. Max Milner of UNICEF has agreed to draft such a document.

PAG WORK IN PROGRESS

The PAG is presently preparing a booklet on general development in the edible protein field, a booklet on technical aspects of protein-rich food development, a comprehensive guideline for the marketing of protein-rich products, and a manual on feeding infants and young children with special emphasis on home-prepared foods.

Development in the edible proteins field

For the information of the United Nations Advisory Committee on the Application of Science and Technology to Development (ACAST), the PAG Secretariat with Professor Francis Aylward, Department of Food Science and Technology, Reading University, England, as a consultant prepared a report on progress in the edible proteins field. This report reviews the present protein supply situation and the prevalence of protein calorie malnutrition in the world. It briefly reviews recent efforts on the part of governments, international agencies, foundations, bilateral groups, and other organizations active in this field and it points out areas where added research or development efforts are considered necessary. The report was reviewed by the PAG at its 17th Meeting in May 1970. The PAG considered it of general interest and recommended that it be published. Professor Aylward and the PAG Secretariat are presently collaborating in preparing a revised version of the report, suitable for general publication as a booklet which may be issued in the same series as "Lives in Peril" described on page 34.

Development of protein-rich foods

Dr. Elizabeth Orr and other workers at the Tropical Products Institute, London, England, are presently preparing on behalf of the PAG a booklet which will review experience gained with various protein food projects. The booklet will consider the impact which the activities of the Protein Advisory Group have had on development in this field. The manuscript will soon be finished, and it will also be published in the same series as "Lives in Peril".

Marketing guideline

Professor Bo Wickstrom, Department of Marketing, Gothenburg School of Economics and Business Administration, Sweden, is presently preparing for the PAG ad hoc Working Group on Marketing a draft for a comprehensive guideline on planning marketing of protein-rich foods. The manuscript will be considered by the PAG ad hoc Working Group on Marketing at its meeting in November 1970 and will subsequently be published by the PAG.

Manual on feeding infants and young children

Dr. Yngve Hofvander of the Pediatric Clinic, University Hospital, Uppsala, Sweden, is collaborating with Dr. Margaret Cameron, Northern Polytechnic, Department of Home Economics, Dietetics and Institutional Management, London, England, in preparing a manuscript for the manual which will eventually be published under the auspices of the PAG.

PAG : FURTHER STUDY OF DOCUMENTATION NEEDS

The PAG Secretariat is interested in obtaining views on the need for abstracting and documentation services in the edible protein field.

The PAG at its 17th Meeting in May 1970 reviewed Dr. Li's study mentioned above and decided that every effort should be made to enlarge the PAG Bulletin to a quarterly with a more extended coverage along the lines proposed in the study.

In addition, the PAG recommended that the PAG Secretariat look further into the question of possible needs for abstracting services and documentation assistance and means of meeting the world needs in this field.

The PAG Secretariat is interested in any comments which readers of the PAG Bulletin might care to give on this subject.

RECENT ADVANCES IN SOYBEAN MILK PROCESSING TECHNOLOGY

By Malcolm C. Bourne, Visiting Professor of Food Science, University of the Philippines, College of Agriculture, College, (Los Baños), Laguna, Philippines. (Permanent address: New York State Agricultural Experiment Station, Cornell University, Geneva, N.Y. 14456, U.S.A.)

The "beany" flavour of soymilk has probably been the principal obstacle to its widespread acceptance. A new technique makes it possible to manufacture soymilk that no longer has this objectionable feature. Therefore, soymilk should be reexamined in order to determine its potential for supplying a low-cost protein beverage with adequate organoleptic properties as a means of increasing the protein intake of protein-deficient diets.

The soybean is an excellent source of protein. Its protein content is high, the protein quality is good, and the soybean is cheap. In the Philippines the soybean provides the cheapest source of protein available among the usual foods (7). Table 1 shows that the soybean provides almost twice as much protein per peso as its nearest competitor, the mungbean, and nineteen times more protein per peso than pork.

In view of their high protein content and low cost it would seem that soybeans would be featured prominently in the diet of protein-deficient countries. Such is not the case; the direct human consumption of soybeans is generally very low. The reason for this is easy to determine. Soybeans are not very appetizing to eat and their acceptability is low for most palates. There has therefore been a search for processing techniques that will make the soybean more acceptable in flavour and texture.

One of the easiest products to make from soybeans is a water extract, which is usually called "soymilk" because of its milky appearance. Soymilk is made by immersing soybeans in water for several hours until they are saturated, then grinding the beans finely with water. Almost any kind of wet-grinding machine will do. The slurry of beans and

TABLE 1. COMPARISON OF SOYBEAN WITH OTHER PROTEIN SOURCES IN THE PHILIPPINES

Food	Grammes protein per kilo (as purchased)	Grammes protein per peso* (as purchased)
Soybean	391	559
Mungbean	244	287
Maize	87	263
Peanut (shelled)	256	213
Dried shrimp	524	210
Rice	74	123
Skim milk powder	360	115
Bread	101	101
Pork	102	29
Sweet potato	5	21

*Based on prices at Bayambang, Philippines, Jan.-June 1965.

TABLE 2. VOLATILES FOUND IN COLD-GRIND SOYBEANS

- Pentane
- Pentanal
- 1-Penten-3-ol
- Hexanal
- Hexanol
- 2-Hexenal
- 2,4-Hexadienal
- Hexanoic acid
- Heptanal
- 2-Heptanone
- Heptanoic acid
- Octanal
- Octanol
- 3-Octanol
- 3-Octanone
- 2-Octanone
- 2-Octenal
- 1-Octen-3-ol
- 2-Octen-1-ol
- 1,7-Octadiene
- Nonanal
- 2-Nonenal
- Decane
- Heptadecane
- Vinyl ethyl ketone
- Vinyl amyl ketone
- Propylfuran
- Pentylfuran
- Benzaldehyde
- n-Propylbenzene
- n-Butylbenzene
- Benzathiazole
- Diphenyl ether
- gamma-Nonalactone
- 2-trans-4-cis-Heptadienal
- 2-trans-4-trans-Heptadienal
- 2-trans-4-cis-Decadienal
- 2-trans-4-trans-Decadienal
- 2-trans-4-cis-Nonadienal
- 2-trans-4-trans-Nonadienal
- 5-Hydroxymethylfurfural

water is strained or filtered in order to remove insoluble residue. The milky-looking water extract contains about 65 percent of the total solids, more than 80 percent of the protein, and most of the oil of the bean. About 1 percent of the protein and 2 percent of the total solids is lost in the soak water and the insoluble residue contains all the fibre, about 33 percent of the total solids and about 17 percent of the protein (4, 3).

The Chinese discovered the process of making soymilk about two thousand years ago. It appears that it should be a major contributor in solving the protein malnutrition of tropical countries. The problem is that soymilk has a strong disagreeable flavour. The flavour has been described as "beany", "bitter", "painty", and "throat-catching"; no matter what you call it, most people find it objectionable.

About ten years ago the Food Technology Group at Cornell University became interested in the soybean as a rich source of low-cost protein. They quickly came to the conclusion that soymilk provided a good vehicle to bring a nutritious, low-cost protein food to people in the developing countries but that the unpleasant flavour of soymilk was the principal obstacle to its widespread acceptance. A lengthy study of the chemistry, biochemistry and nutritional value of the soybean was initiated. At the present time, this work is being supported by a research grant from the U.S. Agency for International Development. Particular emphasis has been placed on determining the origin of the bad flavour of soymilk.

It was found that the enzyme lipoxidase, which is naturally present in the soybean, was the cause of the trouble. As soon as the soybean is ground with water the lipoxidase acts on the unsaturated fatty acid chains, producing a large number of smaller molecular weight compounds (6). By means of modern sophisticated chemical techniques such as gas-liquid chromatography, mass spectrometry, nuclear magnetic resonance, and infrared and ultraviolet spectrometry, eighty volatile compounds were isolated from soymilk and forty-one of them were identified. They are listed in Table 2.

The majority of these compounds are aldehydes, ketones or alcohols. At least thirty-one of these volatile compounds have some flavour impact and, with few exceptions, the flavour of the compound is unpleasant. One compound in particular, ethyl vinyl ketone, has a typical beany note (5). The addition of five ppm of ethyl vinyl ketone to a bland-flavoured milk imparts a distinct beany flavour.

A mechanism of formation of ethyl vinyl ketone from the linolenic acid portion of the fat component of soymilk has been postulated (5). The ethyl vinyl ketone is formed in six steps through free-radical and peroxide intermediates and is catalyzed by the lipoxidase.

The problem was how to inactivate the lipoxidase before it caused flavour damage. Heating the milk immediately after grinding did not work because the lipoxidase acted so rapidly that the beany flavour was evident no matter how quickly the milk was heated. Heating the beans before grinding inactivated the lipoxidase and solved the flavour problem, but it also rendered the protein insoluble, thus giving a suspension of cells and almost no true milk. After many trials the answer to the problem was found, and it proved to be a very simple solution. Instead of grinding the beans with water at ambient temperature, the beans were ground with boiling water. This simple modification of a centuries-old technique inactivates the lipoxidase before it produces the unpleasant flavour, and at the same time brings the protein into solution before it is rendered insoluble by the heat.

This so-called "boiling-water" grind produces a soymilk that is bland and pleasant tasting. The objectionable beany flavour is entirely absent if the temperature is maintained above 80°C (180°F) during the entire grinding process. A pleasant odor and taste that resembles cooked cereals is present. Only one volatile compound is present in detectable concentration in the milk. This is 1-octen-3-ol, which is formed in the intact beans during the initial soaking period (1). The flavour of 1-octen-3-ol is mildly pleasant; in fact it is one of the constituents of mushroom flavour.

The boiling-water-grind technique has not been patented and is available free and without license to any interested party.

The flavour difference between the regular soymilk and the boiling-water-grind soymilk can be easily demonstrated in any laboratory or kitchen that possesses a Waring blender by using the following technique. Soak about one-half cup dry soybeans in water at ambient temperature for several hours. Drain off the water and divide the beans into two equal portions. Place one portion of beans in the blender, add 2 cups water at ambient temperature and blend for 2-3 minutes. Pour into a basin and sniff; the typical beany odour will be strongly evident. Now preheat the blender bowl by filling it with boiling water and blending for 2-3 minutes. Discard this water. (Caution:if the blender bowl is made of glass, bring it to 100°C in several steps in order to avoid cracking by thermal shock). Place the second portion of beans in the blender, add 2 cups of boiling water and blend for 2-3 minutes. Pour into a basin and sniff; the beany odour will not be present. Instead there will be a faint pleasant odour that resembles cooked cereal. The difference in odour and taste of the two soymilks is dramatic.

Research is now under way with the Food Technology Group of the University of the Philippines, College of Agriculture, at Los Baños to adapt the boiling-water-grind technique to Philippine conditions and to make a soymilk that is highly acceptable to the Philippine palate. This research effort is working in two directions.

The first consists of developing a commercial process for a sterilized soymilk in seven-ounce bottles that will appeal to the Philippine palate. This phase is almost complete. The bottled product will keep a good flavour for 4 to 6 months in regular storage in a tropical climate without refrigeration. We hope to interest a commercial processor in marketing this product in the same manner as carbonated beverages. We believe that it can be marketed at the same price as carbonated beverages. Each bottle will supply at least six grammes of high-quality protein. Extensive taste studies with hundreds of children and adults in the Philippines have shown that a bottled sterilized soymilk with 7 percent added sugar and 20 ppm to 40 ppm of a commercial essence of vanilla gives an acceptability ranging from 83 to 96 percent, depending upon the temperature of serving and the time of day. This consistently high level of acceptability is very encouraging. We are prepared to demonstrate the complete process to any interested party at the food technology pilot plant in Los Baños, Philippines.

The second attempt is to develop a boiling-water-grind technique suitable for the village level. The goal is to develop a process that will produce five gallons of good-quality milk per hour, using manual power only and with the capital cost for equipment not to exceed fifty dollars (U.S. $50.00). The objective here is to produce a milk locally each day and sell it in bulk, without sterilization and without refrigeration. This product should have a shelf-life of about 8 hours before spoilage. In rough cost calculations we estimate that by such a process one would be able to sell milk at slightly less than two cents (U.S.) per serving and make a net profit that is higher than the minimum Philippine daily wage on a sales volume of 10 gallons per day. At present there is no suitable process that meets these goals but research is directed towards this end.

Table 3 shows the procedure for making a sterilized soymilk in bottles and a bulk milk to be dispensed from a container. It is very important that the temperature be maintained at or above 80°C (180°F) throughout the grinding process. If the temperature falls below this level there will be some lipoxidase activity. The beany flavour is so pungent that even a small amount of beany-flavoured milk is sufficient to taint a whole batch. In order to maintain a minimum temperature of 80°C it is necessary to preheat the grinding machine, to ensure that the water is boiling (at 100°C, not 95°), and that the correct ratio of beans to boiling water is always maintained.

This procedure will give a milk with approximately the same protein content as cow's milk and a fat content about one-third that of cow's milk. The exact final composition will depend upon the fat and protein content of the soybeans that are used, and on certain processing variables. The calcium content is much lower than that of cow's milk, but it

TABLE 3. BOILING-WATER PROCESS FOR SOYMILK

1. Soak whole beans in water at ambient temperature 5 - 10 hours. Discard soak water.
2. Preheat grinder with boiling water.
3. Grind cold beans with fresh boiling water.
   9 parts by weight water plus 2 parts by weight soaked beans.
   minimum slurry temperature 80°C at all times.
4. Filter. (Filter cake is used for animal feed or human food).

Bottled Soymilk	Fresh Soymilk
5. Formulate (sugar, fat, minor nutrients).	Hold at boiling point for 30 to 60 minutes to destroy antitrypsin.
6. Fill into 7-oz bottles and seal.	Formulate (sugar, flavouring).
7. Sterilize 12 min at 121°C (250°F).	Refrigerate.
Shelf life: 6 months.	Shelf life: 1 - 5 days with refrigeration; 8 hours without refrigeration.

TABLE 4. ESTIMATED INGREDIENT COST OF SOYMILK

	U.S. $
Soybeans, 1.0 kg at 20 cents/kg	0.200
Sugar, 0.65 kg at 22 cents/kg	0.143
Flavouring, 0.3 ml at $6.00/kg	0.002
Total ingredient cost	$ 0.345

Yield of soymilk: 50 x 200 ml servings per kg beans

Ingredient cost per serving: $\frac{0.345}{50} = 0.69$ cents

Feed value of filter cake has not been taken into account.

can be increased to any desired level by fortification with calcium salts. The fat content can be raised by adding a bland oil and homogenizing. The protein effeciency ratio of this soymilk is in the range of 2.2 to 2.4 adjusted to a casein standard with a PER of 2.5 (2).

Table 4 gives a rough cost estimate for the ingredients of a seven-fluid-once serving of soymilk. Other cost factors such as labor, fuel, overhead and selling expenses would have to be added. The important thing is that for less than one cent ingredient cost, a substantial contribution can be made to the daily protein intake by means of a highly-acceptable, refreshing beverage.

Table 5 shows the percent of daily protein intake supplied to various age groups by one seven-fluid-ounce serving of soymilk. Two standards of reference are listed; one is the FAO-WHO recommended daily protein intake and the other is the WHO-Interim Standard for the Western Pacific, which is about 20 percent lower than the FAO-WHO world standard (8). Using either scale it can be seen that one serving of soymilk can supply a significant proportion of the daily protein requirement to every age group. In the age group most susceptible to protein-calorie malnutrition, the preschool child, a single serving of soymilk can supply as much as 50 percent of the recommended daily protein intake.

The milk that is made by the boiling-water-grind method is bland in flavour and acceptable to most people. It can be formulated in many different ways in order to comply with regional taste preferences, traditions, or with special nutritional needs. The soymilk can be flavoured with chocolate, coconut, raspberry, caramel, and most other flavours. It can be fortified with extra fat or with minerals and vitamins. The sugar content can be changed to suit the taste of any group. The correct combination of sugar, fat and synthetic butter flavour gives a product that approaches cow's milk in flavour. It can be used successfully to tone the high-fat milk of water buffalo in order to reduce the fat content to that of cow's milk without reducing the protein content. It lends itself to adaptation to almost any situation.

A substantial amount of formulation research is now needed. This should follow two distinct lines: a) to develop new flavour formulations that will have a particular taste appeal to each national group, and b) to determine what fortification with vitamins and minerals would be desirable in order to remedy deficiencies of minor nutrients in each national group.

A bottled sterilized soymilk has been marketed successfully by commercial enterprises in Hong Kong, Malaysia and Singapore for many years. These milks have a noticeable beany flavour, although the beany flavour has usually been attenuated by means of some form of steam distillation which strips out a high proportion of the volatile flavour compounds. Although these bottled soymilks have been a success where there is a Chinese population, attempts to market soybean milk in other areas have generally failed. It seems that the Chinese do not object to the beany flavour of soymilk while most non-Chinese find the beany flavour highly objectionable. Since it is now possible to produce soymilk that is free from the beany flavour it would be appropriate to reexamine the potential of soymilk for supplying a highly-acceptable, low-cost protein beverage to those countries where protein malnutrition is prevalent.

Summary

A study of the flavour chemistry of soymilk has identified the volatile organic compounds that impart the characteristic "beany flavour" to soymilk. These compounds are not present in the intact bean but they appear as soon as the beans are comminuted. They are formed by the action of the enzyme lipoxidase on the unsaturated fatty acid chains of the oil fraction of the soybean.

Inactivation of the enzyme can prevent the formation of these volatile off-flavour compounds. If the beans are cooked before grinding the lipoxidase is inactivated and the product has a bland flavour free from beany notes. However, the cooking renders the protein insoluble and the resulting product is a suspension of cells rather than a true colloidal protein-fat emulsion. If uncooked beans are ground in water, followed by heating of the bean-water slurry, the beany flavour is pre-

TABLE 5. PROTEIN SUPPLIED BY SOYMILK*

Type of Person	WHO-Western Pacific Interim Standard for Daily Protein Intake		FAO-WHO Recommended Daily Protein Intake	
	standard grammes	% of standard supplied by 7 fl oz soymilk	standard grammes	% of standard supplied by 7 fl oz soymilk
Toddler (1 to 3 years)	11.7	51	14.3	42
Preschool (4 to 6 years)	14.6	41	17.5	34
Schoolage (7 to 9 years)	18.4	33	24.9	24
Schoolage (10 to 12 years)	22.4	27	31.0	19
Schoolage (13 to 15 years)	32.8	18	41.1	15
Adult male	39	15	46	13
Adult female	35	17	39	15
Lactating female	38.5	16	54	11

*Figures based on a minimum of 6 grammes protein in 200 ml soymilk.

sent. The flavour compounds are formed so rapidly that the product has a beany flavour no matter how quickly it is heated to the lipoxidase inactivation temperature after grinding.

A new technique has been developed in which the beans are ground in a preheated grinding machine with the correct amount of boiling water. With this procedure, the enzyme is inactivated before it can form the off-flavour compounds and the protein is brought into solution before the heat makes it insoluble. It is important that the temperature of the bean-water slurry be maintained at or above 80°C at all times during the grinding operation. The result is a milk that is completely free from the notorious beany flavour of soymilk. It is a true colloidal solution-emulsion that is stable and will not precipitate or settle on prolonged standing.

The research groups working at Cornell and in the Philippines are prepared to supply reprints, answer questions, and give pilot plant demonstrations to any interested parties. In the United States, contact Dr. W.B. Robinson, New York State Agricultural Experiment Station, Cornell University, Geneva, N.Y. 14456, U.S.A. In the Philippines contact Dr. M.C. Bourne, UPCO, College, Laguna, Philippines.

References

1. Badenhop, A.F., and W.F. Wilkens. 1969. The formation of 1-octen-3-ol in soybeans during soaking. J. Am. Oil Chem. Soc. 46: 179-182.

2. Badenhop, A.F., and L.R. Hackler. 1970. The effects of soaking soybeans in sodium hydroxide solution as a pretreatment for soymilk production. Cereal Chemistry.

3. Hackler, L.R., D.B. Hand, K.H. Steinkraus, and J.P. Van Buren. 1963. A comparison of the nutritional value of protein from several soybean fractions. J. Nutri. 80: 205-210.

4. Hand, D.B., K.H. Steinkraus, J.P. Van Buren, L.R. Hackler, I. El Rawi, and H.R. Pallesen. 1964. Pilot-plant studies on soymilk. Food Technol. 18: 139-142.

5. Mattick, L.R., and D. B. Hand. 1969. Identification of a volatile component in soybeans that contributes to the raw bean flavor. J. Agr. Food Chem. 17: 15-17.

6. Wilkens, W.F., L.R. Mattick, and D. B. Hand. 1967. Effect of processing method on oxidative off-flavors of soybean milk. Food Technol. 21: 86-89.

7. World Health Organization. 1969. The health aspects of food and nutrition. Western Pacific Regional Office, Manila, Philippines. Pp 24, 25.

8. World Health Organization. 1969. The health aspects of food and nutrition. Western Pacific Regional Office, Manila, Philippines. Pp 244, 245.

A RESEARCH AND TRAINING CENTRE IN NIGERIA

An international agricultural research and study centre has been dedicated in Ibadan.

An International Institute of Tropical Agriculture to serve as a research and training centre was established in April of this year in Ibadan, Nigeria. It is sponsored jointly by the Ford and Rockefeller Foundations. Three such centres are already in operation in the Philippines, Mexico and Colombia. The Institute will concern itself with research on locally-grown food crops with the goal of increasing production and improving nutritional quality, with special reference to protein. The Institute is expected to be completed in 1972 and will serve as a training centre for plant scientists from all over the world.

NUTRITION INTEGRATED RESEARCH PROGRAM OF IBP

The International Biological Programme (IBP) includes a number of research projects. The following gives summaries of those projects which relate to protein food development. It is anticipated that the IBP Report No. 3, Part 3, in which the summaries of all the projects will be published, will appear during the summer of 1970. The summaries given here are quoted as they were received from the American Institute of Nutrition, Bethesda, Md., U.S.A.

Development of food from cellulosic wastes

Investigators:
C. D. Callihan, F. A. Pryor, Y. W. Han, C. E. Dunlap, V. R. Srinivasan, and W. F. McKnight, Lousiana State University, Baton Rouge, La. 70803, U.S.A.

Studies on the development of food from cellulosic wastes have a bearing on two important problems: (1) that of the ever-increasing pollution with waste material cellulosic in nature and (2) the importance of producing more food containing high quality proteins. A pilot plant has been constructed in which cellulosic wastes are converted to microbial proteins. This process involves a delignification step using mild caustic followed by a fermentation which involves a cellulolytic organism, Cellulomans, a species not previously isolated.

Preliminary studies of the product produced, that is the group of bacterial cells, indicate that when fed to rats at a level of 40% of the diet this material is nontoxic. There is also indication that the product which contains 50% protein, when supplemented with methionine, supports a moderate rate of growth in rats.

Research is continuing on several phases directed toward elimination of steps in the production process to reduce costs and the development of mutations of the organism used to provide a better balanced amino acid composition of the protein. Also, future studies will be directed toward the quality of the protein for food uses and the acceptability of the product as human food.

Development of soy-based foods of high nutritive value

Investigators:
W. B. Robinson, L. R. Hackler, J. C. Moyer, K. H. Steinkraus, and J. P. Van Buren, Department of Food Science and Technology, New York State Agricultural Experiment Station, Cornell University, Geneva, N. Y. 14456, U.S.A.; M. C. Bourne, University of the Philippines, College of Agriculture, Laguna, Philippines.

In providing for an increase in world production of protein, soybeans are a principal source to meet this demand. To assure human acceptability of soybean products many studies of processing have indicated improvement in the flavor and texture of soy products for food use.

Soybeans are normally prepared by soaking in water before the grinding operation. The soaking procedure over a period of several hours allows the development of off-flavors caused by enzyme activity. One prominent product is 1-octen-3-ol, which has a mushroom-like odor. This is reduced by use of water temperatures over 50°C; however, yields of solids in filtered milks are lowered. Extended studies on the flavor formation and the enzymic causes of flavors have led to a number of suggestions for improved processing.

The rancid flavor of the soymilk as traditionally prepared resides in the volatile fraction. Prevention of rancidity and the production of a bland tasting milk low in beany flavor is achieved by wet grinding the soaked beans at 80°C or higher.

The effectiveness of grinding procedures was followed by particle-size measurements using a combination of wet sieving and sedimentation tests. Hammer mills were as effective as attrition mills, while colloid mills were more effective, lowering the particle size below 0.05 microns.

The protein redispersibility of dried soymilks was increased by processing under conditions that split disulfide bonds and prevented sulfhydryl and hydrophobic interactions.

Roasting of nuts and legumes is carried out principally for desirable flavor and textural changes but, in the case of soybeans, also improves nutritional quality by destroying antitrypsin. Roasting is carried out either after soaking the beans, followed by a dry roasting process, to provide a soynut with a desirable tender texture or by deep fat frying of beans following the soaking step.

Studies are continuing on the further development of new and acceptable high protein foods of low cost. (See also the article on page 14).

Evaluation of fish protein concentrate

Investigators:
C. O. Chichester, Dept. of Food Science and Technology, University of California, Davis, Calif. 95616, U.S.A. and Fernando Monckeberg, Dept. of Pediatrics and Biochemistry, School of Medicine, University

of Chile, Santiago, Chile.

In Chile, as in most developing countries, one of the most serious medical social problems is chronic infant malnutrition retarding development and growth and promoting low psychological performance with high susceptibility to infection. Efforts to improve protein intake have been directed to utilization of fish protein concentrate (FPC) in preschool children's food carried out in a single site near Santiago. This work will be extended to other areas during the next year.

Chemical composition, biological quality of the protein, and toxicity were determined for FPC, sunflower presscake meal (SPM) and foods supplemented with these concentrates. Acceptability and tolerance were tested in human trials. The FPC improved the biological quality of cereal-based foods and promoted normal growth in infants. Mixtures containing FPC and SPM showed a high net protein utilization in the rat and produced normal growth in infants aged 1 to 5 months when they supplied 100% of the total daily dietary protein.

Continuing studies on other sources of protein involve detoxification of rapeseed meal for both animal and human consumption. In view of the ready supply of this source of food it is important to provide a rapeseed meal protein concentrate suitable for human use.

Efforts are continuing to encourage the use of FPC in other areas of the world through a system of monitoring ongoing experiments in several countries to make certain that the nutritional, economic and acceptability aspects of foods supplemented with FPC are given appropriate consideration in the experimental protocols.

Food composition table for use in East Asia

Investigators:
W. T. Wu Leung, Nutrition Program, Health Services and Mental Health Administration, U.S. Dept. of Health, Education and Welfare, Rockville, Md. 20852, U.S.A.; Mrs. R. R. Butrum, supported by the National Institute of Arthritis and Metabolic Diseases, National Institutes of Health, Bethesda, Md. 20014, U.S.A.

This project is sponsored jointly by three institutions, two agencies of the U.S. Department of Health, Education and Welfare, the National Institute of Arthritis and Metabolic Diseases of the U.S.A., the U.S. National Institutes of Health, and the Nutrition Program of the Regional Medical Programs Service in the U.S.A.; and by the Food and Agriculture Organization of the United Nations.

The countries represented in the information on food composition are: Burma, Thailand, Laos, South Vietnam, Cambodia, Malaysia, Singapore, Indonesia, Philippines, Taiwan, Korea, and Japan. Collection of data is being made on the proximate composition, minerals, vitamins, amino acids, fatty acids and trace elements that are of nutrient value. Information is accumulated through communication with key investigators, with libraries, and with other sources of scientific publications in the countries of interest. Information is being tabulated in a format previously used for the African Food Composition Table and will be published in both English and French. It is hoped that any laboratory having accurate information on composition of foods of East Asian countries will communicate such information to the principal investigators.

Improved methods of extracting and utilizing plant proteins

Investigators:
Keith H. Steinkraus, L. Ross Hackler, and A. G. van Veen, New York State Agricultural Experiment Station, Cornell University, Geneva, N.Y. 14456, U.S.A.

Fermented foods are important components of diets in many parts of the world. A study of the value of fermentation in improving nutritive quality of food has been carried out. Fermentation does not generally improve the nutritive value of the protein but may increase vitamin content. Digestibility for humans of certain fermented foods such as tempeh, ontjom, and bongkrek is improved and the keeping quality is generally increased. Cooking time is often decreased. Organoleptic characteristics are generally improved. The wholesomeness of fermented foods is generally as good as and, in some cases, better than that of the ingredients from which they are produced. When aflatoxin-containing ingredients are used there may be a hazard to health.

The effect of fermentation was studied in improving the process of extracting oil and protein from coconut meat. Coconuts available commercially vary widely in maturity and length of storage and in response to fermentation processing. Sixty percent of individual coconuts showed a breaking of emulsion with separation of oil and proteins when fermented under controlled conditions. Conditions of grinding and range of dilution for rapid fermentation were critical. The organism Lactobacillus plantarum was most successful in breaking the emulsion to yield a high-grade clear oil and with precipitated protein easily recovered in relatively undenatured form.

Other studies on low-cost protein-rich foods are continuing.

Increased protein supplies through peanut improvement

Coordinator:
W. K. Bailey, Crops Research Division, Agricultural Research Service, Beltsville, Md. 20705, U.S.A.

Cooperative research in the U.S.A. and in India indicates that the protein content of peanut seed could be increased by breeding. Average protein content of sound mature seed of a large number of diverse peanut genotypes from India and U.S.A. ranged from 23.6 to 30.5 percent when the genotypes were grown at Ludhiana, India or at Tifton, Georgia. The possibility of increasing protein content of seed by breeding appears more favorable for peanuts of Virginia botanical type than for Spanish.

An obvious way to increase protein supplies is the use of higher yielding varieties. When 100 diverse genotypes from India and 100 diverse genotypes from the U.S.A. collection were grown at Ludhiana, India, from 1964 to 1966 in small-scale replicated tests, several Indian and U.S.A. genotypes substantially outyielded standard checks. The most promising of these have been included in larger scale tests at Ludhiana. In general, the U.S.A. genotypes that gave superior yields at Ludhiana show a high yield potential when grown in adapted areas in U.S.A.

In cooperative peanut variety improvement research with the Georgia and Oklahoma Agricultural Experiment Stations in the U.S.A., three new productive Spanish peanuts of medium seed size were released to growers in 1969 and 1970. These are (1) Spanhoma, a pure line selection from Argentina; (2) Tifspan, selected from progeny of a cross between Argentine and Spanish 18 - 38; and (3) Spancross, selected from progeny of a cross between Argentine and the wild annual, decumbent species Arachis monticola. Argentine is a pure line selection from Plant Introduction 121070, which was introduced into the U.S.A. from Argentina in 1938.

Exchange of peanut genotypes and production know-how is continuing with India and other countries where the crop is grown throughout the world. Research is continuing in U.S.A. on effect of genotype and production environment on protein content of mature peanut seed. In our peanut variety improvement research special emphasis is placed on increased yield potential, resistance to pests, and enhanced processing and nutritional quality.

Published reference:
K. T. Holley and R. O. Hammons. 1968. Strain and seasonal effects on peanut characteristics. Univ. of Georgia College of Agriculture Experiment Stations Research Bul. 32. April. 27 pp.

Nutritional value of wheat and wheat products

Investigators:
W. A. Gortner and E. W. Toepfer, Human Nutrition Research Division, Agricultural Research Service, Beltsville, Md. 20705, U.S.A.

Wheat makes up over 80 percent of the cereal products consumed as food in the United States. A most comprehensive study in terms of numbers of nutrients determined and numbers of wheat products studied has been conducted to provide up-to-date information on the nutrient contributions of wheat and wheat products. Five hard wheats, four soft wheats and two durum wheats and the flours milled from these wheats have been analyzed for four B vitamins, tocopherols, 15 fatty acids, 14 minerals, protein and amino acids. Not only were the various forms of the vitamins measured but determinations were made of changes that occurred during milling and processing.

Only 5 of the 15 fatty acids were present in significant amounts in the samples studied. Linolenic acid occurred in the largest amounts. Individual samples from all regions of the country had essentially the same fatty acid composition. About 10 percent of the tocopherols present in hard and soft wheats and 40 percent in durum wheat survived the milling and bleaching process. Over two-thirds is in the form of epsilon-tocopherol and less than 10 percent has the alpha form.

Major losses occurred in the B vitamins, thiamin, riboflavin, niacin and vitamin B_6 with less than 20 percent remaining after 60 percent extraction.

Changes in mineral content were significant with less than 25 percent of the iron, phosphorus, potassium, copper, magnesium, manganese, nickel, and zinc being retained. As expected, the lower the percent extraction, the less the mineral content. This is important information in view of the essentiality of certain trace elements and the variable availability in foods.

Consumption of diets containing 3-1/2 ounces of unenriched flour daily would provide of the day's allowance: 10% for thiamin, 2% for riboflavin, 8% for niacin, 4% for vitamin B_6, 2% for calcium, less than 10% for iron, 10% for magnesium and 16% for phosphorus.

Protein value of plant foods

Investigators:
Ruth M. Leverton, Mildred Adams, June Kelsay and E. W. Toepfer, Human Nutrition Research Division, Agricultural Research Service, Beltsville, Md. 20705, U.S.A.

The problem of meeting protein requirements with plant proteins when high-quality animal proteins are not available or are not economically feasible is one of great concern. Current research is directed towards supplying information on selected aspects of this problem.

Diets low in protein or containing proteins of poor quality were found to be associated with a decrease in brain glutamic dehydrogenase and decarboxylase and an impairment in psychological performance of the rat. In contrast, mere caloric restriction prior to or following weaning had no such effect. The post-weaning diet appeared to be more important than the maternal diet for development of offspring but the latter did affect breeding performance, birth weight and weaning weight. Dull and bright strains of rats have been developed by selective breeding over four generations and learning ability is being evaluated by selected measurements of psychological performance.

In order to formulate low-cost meals for post-weaning children, investigations are underway to add to our information on the possible supplementation of cereal diets deficient in lysine with legumes containing a high level of this amino acid. Preliminary evaluation of various food combinations will be made using the rat as experimental animal. The most promising combinations will be fed to children 2 to 5 years of age to determine their nutritional response to these diets.

Although there has been limited evidence suggesting that the protein efficiency ratio of tempeh, a fermented soybean product, was superior to that of the unfermented soybean, recent research has failed to confirm this finding. PER ratios of freshly-prepared or stored tempeh and of unfermented soybeans were not significantly different. Protein values of tempeh were improved when properly supplemented with lysine, methionine and threonine. The antioxidant isolated from tempeh was found to be ineffective as a substitute for vitamin E.

The Hague, Netherlands

THE SECOND WORLD FOOD CONGRESS

The Congress, which met at The Hague for two weeks 16 - 30 June 1970 was a very unusual kind of conference to be held by an Organization within the United Nations system, because the 1,800 or so participants were invited to it in their individual capacities and not as representatives of any government or organization as such. This led to a particularly free and uninhibited exchange of views, which was valuable in that it let new currents of general public opinion into the sometimes rather formal atmosphere prevailing in international organizations. The following is a quotation from the official release.

"The Second World Food Congress is now over. In order to coordinate and stimulate the follow up, the Secretary-General's Office will issue a number of Information Bulletins, of which this is the first.

1. A few facts on the Second World Food Congress

The Congress was attended by 1867 participants of whom more than 600 came from developing countries and about 300 were under 30 years of age. During the two weeks of the Congress more than 1000 people took part in the various discussions in plenary sessions or in Commissions and it may be said that the Congress provided a genuine dialogue of a liveliness and vigour unusual in international meetings. As the Final Declaration stated, "the dialogue initiated at this Congress must continue. Food and development are too important to be left only to the experts".

The main themes which emerged from the Congress discussions are reflected in the Final Declaration, a copy of which is attached. Two were repeated constantly: the importance of influencing political decisions as to national priorities and the use of national resources; and the need to ensure that the benefits of development reached to all levels of society. Exploitation, social injustice, and the misuse of the world's resources were constantly attacked. Underlining all these themes was the recognition of the need to "build a world partnership for progress"; in other words, to make development the common preoccupation and concern of all nations and all peoples.

2. Youth in the Congress

There is no doubt that the constant, vigorous and often provocative interventions by the younger participants went far to set the tone of the Congress. In plenary sessions and in the Commissions they were constantly active. There was no single "youth" view, but in general their contributions were radical and critical. They pointed always to the political decision making on which development depends; demanded action to ensure that the benefits of development should be available to all; attacked exploitation and social injustice, and referred constantly to the need to examine, and, where necessary, change existing power structures. Younger participants from developing countries insisted on the need for greater participation in planning and in the selection of objectives by those for whose benefit plans were to be made, and insisted that the priorities of the developing countries themselves ought to be decisive in the selection of programmes.

3. Follow up of the Congress

The Declaration of the Congress and some of its conclusions will be discussed at the Freedom from Hunger Campaign and FAO Regional Conferences but it is hoped that all participants - FFHC Committees, NGOs or other groups - will use the Congress in special meetings or post national congresses in their own country. It is very important that the discussion started in The Hague is carried out through the various sectors of society in all the countries from which participants came to The Hague. That can be done through meetings but also through articles, TV and radio programmes, round-tables or lectures. The Secretariat can provide the text of the documents issued in The Hague. The final report is now in preparation but will not be ready for some time. Other information material can be obtained from the Information Division, including photos and tapes.

Final Declaration of the Second World Food Congress

Food is the first need of every human being-a fundamental human right. But for hundreds of millions throughout the world that need is not met and that right is denied. This is intolerable.

We came to the Second World Food Congress determined to unite in an all-out attack against the scourge of poverty and hunger. Recent technological advances have stirred our hopes but the inadequate pace of economic and social development has deepened our frustration.

Men and women of many countries, age groups and professions, with deep but often conflicting convictions, we have confronted each other in complete frankness. The dominant theme was immediate action. We value the opportunity for this unique dialogue.

Our overriding and unanimous conclusion is positive. The battle against hunger and underdevelopment can be won. A "green revolution" is under way in many developing countries. Everywhere groups begin to attack public apathy toward development. The Indicative World Plan broadly shows the contribution that agriculture can and must make.

But victory depends on a massive effort by the entire world community. It is not enough to think only of food. The total development of every man, woman and child is at stake. It is thwarted by injustice, exploitation, discrimination and all manifestations of human selfishness. Many believe that this scandal can only be ended by a radical transformation of contemporary power structures, international economic relations and social values.

We cannot wait for these problems to solve themselves. They are so vast and intricate that their solution requires the active participation of every single person. We must act now.

We will urge support for our governments in all authentic efforts to build the world-wide partnership for progress to which people aspire, but we can no longer tolerate empty pledges.

All governments must drastically increase the supply of resources for development and channel an increasing proportion through an improved system of international cooperation. Is it not insane to spend such vast sums on armaments when resources for development are so desperately needed?

Governments must ensure that knowledge of different population policies is available to all, and that people are free to follow the mandates of their own conscience in the matter of family size.

We urge governments to transform inequitable trade arrangements which are a barrier to development. Increased export opportunities must be provided for the developing countries.

We urge governments to provide farmers and fishermen with the means, services and incentives required to meet growing food needs. Is it not absurd that the men and women who provide our food are so often the object of contempt and neglect? Above all, governments must not shirk any agrarian reform needed to enhance the status and dignity of rural people, improve their incomes and release their energies for increased production. Since insufficient numbers can find productive employment in urban occupations, employment opportunities in rural areas must be increased by all possible means.

FAO and other international agencies should reorient their policies and programmes in line with the findings of this Congress. They must be provided with the necessary means and resources.

We urge FAO and other international agencies to marshall their resources to alleviate the growing threat of contamination and destruction of the environment.

In addition to the assistance they give to governments, FAO and other international agencies must do more to provide national and community groups with the information and other support they require for their development efforts.

We urge private investors to give preference to undertakings which make the maximum contribution to an economic growth which is geared to the basic needs of the people.

We urge those voluntary organizations whose aim is community service to adapt their structures and free their resources for development according to the principles set forth in the findings of this Congress.

We urge producer groups, labour unions, trade organizations and other influential private groups to accept the imperatives of development as a major factor in determining their policies.

The dialogue initiated at this Congress must continue. Food and development are too important to be left only to the experts."

Washington, D.C., U.S.A.

THIRD INTERNATIONAL CONGRESS OF FOOD SCIENCE AND TECHNOLOGY

The SOS'70 Congress considered the world food problem in terms of food science, nutrition and economics. It was held 9 - 14 August 1970.

The programme of the Congress was organized under the broad theme of "The Science of Survival" (termed SOS/70) underlining the immediate need for a vast expansion of the world supply of conventional foods, vigorous effort towards development of new foods both from traditionally used raw materials and new sources not employed previously, and the application of technology and social sciences to deliver acceptable foods with suitable enrichment. The Congress was attended by 1000 - 1500 participants from over fifty countries. They comprised food scientists and technologists, nutritionists and dieticians, pediatricians and public health workers, biologists and chemists, and senior government officials in charge of food, agriculture or public health aspects. The programme was diversified to be of interest to the different specialities and to engage the attention of both industrialized and developing countries. It covered problems of food quality and food quantity and how these could be successfully coped with both within the borders of each country and on a global basis.

The Congress was organized in two plenary sessions, twelve symposia with invited speakers, ten sessions for presentation of volunteered papers, two workshops to specifically discuss the food problems and programmes of developing nations in relation to technical assistance, and several informal, "unstructured" sessions on topics of current interest. The symposia themes included topics such as sensory properties of foods, food laws and regulations, information and documentation, food preservation and protection, new sources of proteins, food acceptance in a changing world, nutrition in relation to food technology, food engineering, physical and chemical properties of foods, training in food science and technology and water supply and waste disposal. Grains and soybeans, nutrition, proteins and marine products are a few of the subjects discussed in sessions for volunteered papers.

The prospects for feeding the world's rapidly multiplying population were discussed at the opening and closing plenary session. It was emphasized that food imports hold little promise for the developing countries in the long run because of the limitation of foreign exchange; it appears that in most cases at least 90% of the food consumed will have to be produced in these countries' own soil. The speakers expressed a guarded optimism about the green revolution and its benefits and felt the urgent need, among other things, for radical land reforms, promotion of high yield agriculture, absorbing increased manpower and putting limits on the size of the population. While it was considered technically feasible to more than double present levels of food production, this will require enormous investments and all the ingenuity and efforts that the scientists and technologists can muster. The developing countries are grappling with insufficient marketing and distribution facilities, huge storage losses, inadequate transportation, poor use of labour, ineffective price policies, and lack of capital and incentives. Some of the experiences of India and some countries of Africa in the battle against undernutrition and malnutrition were explained and the challenging role of food science, technology, nutrition, marketing and distribution in the seventies was emphasized.

The symposia sessions on "Information and Documentation" reviewed the current status of the development of a comprehensive documentation and information service for food science and technology. The history, development and organization of the International Food Information Service were described and the various stages in the production of its abstract journal were discussed. The current trends in mechanized documentation, the problems of indexing, retrieval and selective dissemination of information were some of the other subjects dealt with.

The influence of urbanization, industrialization, population migration, mass media advertising and sales promotion on food habits and their beneficial and harmful effects were discussed in a symposium on "Food Acceptance in a Changing World". The various phases in market research such as product identification, development and marketing trials were described with suitable examples for both the developed and the developing countries.

Like most of the other sessions of the Congress, the symposium on "Nutritional Considerations in the Application of Food Technology" gave an opportunity for nutrition scientists and food technologists to come together and understand and appreciate each others points of view. The nutritional effects of processing and storage were reviewed; the principles and philosophy of vitamin, mineral and amino acid fortification along with the current experience in these fields were discussed; and nutritional specifications for infant and weaning foods were presented.

The symposium on "Biological Evaluation of the Nutritive Value of Foods" reviewed the current status of animal and human testing of proteins for evaluation of quality and indicated the pitfalls in the procedures and the need for caution in the interpretation of results. There was a brief discussion on the ethical considerations in feeding studies on children.

A great many volunteer papers were devoted to the possibilities of developing new protein food products, or utilizing untraditional protein sources. In these considerations, the main emphasis was on scientific, technical and nutritional aspects with problems of acceptability and marketing often not yet explored.

A session on food systems emphasized the need to consider food development as part of total national development and the need to consider nutrition problems in conjunction with all other major aspects of the economy.

A session on nomenclature for food analogues and other new food products concluded that new foods may often merit a designation of their own rather than being termed imitation. However, when they can replace or be confused with existing foods, steps should be taken to safeguard that they are not inferior to these in nutritive value.

The outstanding impressions the Congress generated were that it concerned itself with current food and nutritional problems both in the developing and developed parts of the world and explored the ways of combating them immediately and in the future. It was clearly accepted that the current and future food problems of the world cannot be solved by the food scientists and technologists alone; they need the cooperation and help of other specialists in several fields and particularly, in the early stages of product development, the nutrition scientists. The Congress was successful in getting together the divers specialists and there were several sessions where nutrition workers, food scientists and technologists sat and exchanged viewpoints so as to understand their mutual difficulties and to arrive at satisfactory integrated solutions.

The Congress also gave importance to youth who were represented in large numbers ; particular mention must be made of the thirty-six young student food scientists from various parts of the world who came as special invitees of the Congress.

The Congress held a food exhibition, Food-Expo'70, which gave a preview of commercially produced new foods and provided educational exhibits.

Oberursel, West Germany

OVERCOMING PROTEIN MALNUTRITION IN DEVELOPING COUNTRIES

The eighth Pugwash Symposium was held in Oberursel from 19 to 23 May 1970. This Symposium was organized jointly by the German Foundation for Developing Countries, the Pugwash Conferences on Science and World Affairs, and the Federation of German Scientists. Some thirty scientists from nine countries and from UNDP, the Joint IAEA/FAO Division and FAO attended.

The Symposium discussed and examined the problem of malnutrition from economic, technological, sociological, demographic, physiological, psychological and public health points of view. The Symposium acknowledged the work of FAO, WHO and UNICEF and paid special attention to the Indicative World Plan. It emphasized that nutrition policy should form an integral part of a country's policies and programmes for social and economic development in the 1970s.

Realizing the need for urgent action to solve the problem of malnutrition, the Symposium made a number of recommendations which were to be presented at the Second World Food Congress.

The recommendations made concerned the following:
- Interdependence of food, nutrition and population policies. This covered expansion of commodities, family planning, revision of trade policies of rich countries, overcoming underdevelopment, and improvement of crops and animal and fishery resources.

- Conservation, processing and distribution.

- Research and development in the fields of protein, of crops and animals, and of nutrition status. Cooperation between research institutions and universities in industrialized and developing countries and the creation of an International Science Foundation for support of scientific research in developing countries was strongly supported.

- Interdepartmental, interdisciplinary machinery. Coordination of all governmental activities concerned with nutrition programmes within an interdepartmental body and inclusion in the responsible economic planning institution or council of a nutrition specialist who will act as an adviser on all strategic policies and programmes from a nutritional point of view.

- Selected community nutrition programmes. This covered services for mothers and children and nutrition education.

- Trained manpower requirements. The Symposium stressed the need for establishing training facilities of high standards at the national and regional levels, these centres to provide not only advanced training but also short courses to increase the knowledge and effectiveness of existing personnel. This training should be extended to the medical, paramedical, educational, agricultural and technological personnel.

G. D. Kapsiotis

Geneva, Switzerland

PAG AD HOC WORKING GROUP ON FEEDING THE PRESCHOOL CHILD

The agenda for the first meeting included the following items: nutrition in utero, breast feeding, emergency formulas, introduction of centrally-processed weaning foods in developing countries, and the development of a manual on feeding of infants and children. Preliminary discussions were also held on preschool child food consumption surveys; type and level of fat in infant and weaning foods; implementation channels for preschool nutrition programmes; standards for infant foods; and hygienic aspects. The meeting was held 15 to 18 December 1969.

At its sixteenth meeting in Geneva, September 1969, the PAG recommended the establishment of an ad hoc working group on the special problems involved in the feeding of the preschool child. The first meeting of the group was held in Geneva between 15 and 18 December 1969. The following attended the meeting: Prof. Bo Vahlquist, Sweden; Dr. J. K. Harfouche, Lebanon; Dr. Y. Hofvander, Sweden; Dr. F. Monckeberg, Chile; Dr. A. H. Niehoff, U.S.A.; and Dr. A. Omolulu, Nigeria. Mr. G. Ballarin (Nestlés, Brazil) attended as an observer. Representatives from FAO, WHO and UNICEF and the Caribbean Food and Nutrition Institute, Jamaica, participated in the meeting.

The terms of reference of the group are:

1. To review and make recommendations to the PAG on matters related to:
   a) feeding practices of infants and preschool children; their nutritional status and factors to be taken into account to overcome PCM.
   b) the need for the sponsoring Agencies to prepare educational materials on feeding of children.
   c) priorities of action to reduce the prevalence of PCM and promote better nutrition.
2. Preparation of manuals to provide guidelines related to feeding of infants and children.

A summary of the conclusions arrived at at the meeting follows:

In order to avoid serious effects on physical and mental development, breast feeding up to six months should be encouraged in developing countries by all possible means, including appropriate legislative measures.

In emergencies, where infants do not receive breast milk for any reason, home-made mixtures and processed complete formulations should be developed, essentially based on animal milk wherever possible. Processed formulations for infants below six months should satisfy all the criteria and their free distribution should be under the supervision of personnel of MCH clinics, hospitals, orphanages, etc. Processed supplementary foods for the weaning period are not suitable for young infants.

A manual on feeding infants and young children should be prepared, which will pay special attention to home-made food mixtures for young infants.

More data have to be collected on food consumption of preschool children and for this suitable guidelines have to be developed.

The infant's diet should provide 35 to 50 percent of calories from fat sources. Essential fatty acids should be present at a level of one percent of calorie intake.

More information should be obtained on legislation on maternal protection and on infant foods.

The group will be holding its second meeting in Geneva between 14 and 18 September 1970 for further discussions.

Rabat, Morocco

PRODUCTION OF FISH PROTEIN CONCENTRATE

Various aspects of the feasibility of FPC, both food- and feed-grade, were discussed. The efforts to establish FPC production in Morocco receive good cooperation with and help from international agencies and industrial companies.

The meeting of the Joint UNIDO/FAO Expert Group was convened 8-12 December 1969 to examine the progress made by the SONAFAP FPC plant in Agadir, Morocco, under the UNDP/SIS/FAO/UNIDO project; to discuss and assess the suitability of the available fish protein concentrate (FPC) processing methods for developing countries; and to formulate recommendations for action by industry, governments, the organizations in the United Nations system and bilateral assistance agencies.

The Expert Group consisted of representatives of industry and consultant firms, research workers, and specialists of the United Nations Agencies and of the US/AID. Algeria, Chile, Iceland, the Ivory Coast, Morocco, Peru and the U. S. S. R. were represented by observers. Observers were also present from the equipment manufacturing industry, research institutions and the fish processing industry. A number of technical papers were presented and discussed.

The conclusions and recommendations of the Expert Group Meeting concerned: a) the development of a commercial FPC enterprise in Morocco and b) FPC development in the areas of engineering and production, economic feasibility and marketing, and nutrition.

There were two interesting features of this meeting. One, that US/AID, in cooperation with FAO, UNIDO and UNDP, is making a thorough investigation of the economic feasibility and reorientation of FPC production, utilization and marketing in Morocco. It is interesting to note that high-quality feed-grade FPC has a considerable market potential as a milk replacer in calf feeding. This grade should be produced in parallel with the pure FPC so that the economics are well balanced until FPC finds wide use in human feeding. The second feature was that Pescamino Ltd. A/S, Stavanger, Norway, through its observer at the meeting, proposed its willingness to join SONAFAP as a partner to assist in the development of SONAFAP.

GDK

Rio de Janeiro, Brazil

A MEETING BETWEEN GOVERNMENT OFFICIALS AND PRIVATE FOOD ENTERPRISES IN BRAZIL

A small congress intended to establish a "dialogue" between Government and private enterprise was held in Rio de Janeiro from 12 to 14 May 1970.

The main objectives of this congress were to emphasize the existence of a protein problem in Brazil, to ask the government what is required to solve it on a long term basis, and to spell out the factors which hamper development of solutions and how to overcome them. As a result of this meeting, it was decided to set up, with the participation of technicians from the Government, related national and foreign institutions, universities and foreign enterprises, a special department of protein foods within the Association of Brazilian Food Industry. This department it is believed will become the nucleus of the future "Brazilian Nutrition Foundation" for which some funds are already available.

Zurich, Switzerland

SYNTHETIC AND SUBSTITUTE FOODS - SAFETY AND NUTRITIVE VALUE

A summary of an international symposium, "The challenge of synthetic and substitute foods", held in Zurich, Switzerland, on 5 and 6 February 1970.

Although the term "synthetic foods" is being used generally, few foodstuffs are truly synthetic; only fats synthesized from petroleum oil, and amino acids and vitamins produced in the chemical factory are synthetic. Other foodstuffs may better be termed (a) new sources, including those produced biologically such as single cell protein, and (b) semisynthetic, meaning those prepared from, or in combination with, other foodstuffs, such as artificial rice, textured vegetable protein and artificial milk.

With regard to nutritive value most of these preparations have already been shown to be rich in protein or, in the case of bacterial protein, to provide adequate protein for animal feeds. However, since they are mostly intended to be converted into edible foods any desired nutrients can be added.

New sources of food must be shown to be harmless, and the Protein Advisory Group has already laid down Guidelines for controlling safety. Problems are caused by the high content of nucleic acid in yeast and other single cell organisms which is converted into uric acid. When large amounts of these foods are eaten, blood uric acid may reach undesirable levels.

Similar problems, as yet little investigated, are associated with such "foods" as the giant floating weed (Macrocystis pyrifera) and non-buoyant weeds such as Laminaria.

Bacterial protein is at present intended only for animal feed, and has been thoroughly investigated over the past ten years. It has been shown to be a valuable source of protein, able to replace a large part of the conventional soya and fish meal in chick and pig diets.

If bacterial protein is to be considered for human consumption, problems arise from the composition of the cell wall which contains amino acids not found in the plant or animal kingdom, as well as the D forms of some of the ordinary amino acids.

Other new sources include the conversion of wool protein into an edible form by treatment with sodium sulphide, but this preparation has not been fully tested.

The semisynthetic foods, prepared from conventional and therefore acceptable foods, should not present a problem of safety unless there has been any change during processing. Clearly, processed foods, particularly if they are in any way novel, will have to be demonstrably safe, whereas so-called natural foods are accepted without being tested. The principal foods of this type are the textured vegetable proteins made from spun or extruded soya, so the nutritive value of the protein is high. Human subjects have lived largely on these foods for several months and they have been found to be quite satisfactory. Foods of this type can always be enriched with any desired nutrients.

A. E. Bender

FAO:

LIVES IN PERIL - PROTEIN AND THE CHILD

A booklet reviewing the world protein problem and efforts to solve it. This is the first in a series of booklets, published for or on behalf of the PAG, related to the world food problem.

This booklet was prepared by FAO on behalf of the Protein Advisory Group to make readers aware of the world protein problem, its serious effects on the health and welfare of children of developing countries and the several programmes jointly undertaken by the United Nations Agencies, particularly FAO, WHO and UNICEF, to help National Governments solve the protein problem. It was the joint effort of these Agencies in this field that led to the creation of the PAG.

The booklet is divided into seven sections. In the first, the extent and severity of the problem of protein and other nutritional deficiencies in mothers and in children under five years of age are discussed. Children along with their mothers are numerically dominant, accounting for over two-thirds of the total population of technically developing regions of the world. The National Food Balance sheets while indicating the existence of malnutrition unfortunately do not expose the dimensions of the problem since within individual groups, families, communities and regions of a country, the protein and other shortages may be much more severe than the statistics suggest. Successive generations of children in these regions wear the badge of dietary deficiencies in the form of retarded physical growth and many among them suffer the additional burden of impaired mental development.

The next section describes the nutritive value of proteins, and gives a definition of protein quality and factors which affect it and the common indices for assessment of nutritive quality of proteins. Vegetable sources provide nearly 70 percent of the world's total edible protein supplies; 30 percent is provided by animal sources. While it is clearly impossible to provide the whole of the developing world with "rich meat diets", it is necessary to design strategies to offer everyone the basic requirements of proteins and other nutrients.

The protein requirement and factors affecting it are described in the following section. The stress posed by gestation and lactation is described and the antenatal and postnatal protein needs of the woman are discussed in relation to the foetal and infant nutrition.

A graphic description of the nutritional crisis of the weaning period is given in the fourth section and the different types of deficiency diseases encountered are described. The vicious circle of infection and malnutrition is presented to explain the evolution of kwashiorkor and marasmus and the high occurrence of childhood mortality and morbidity.

Although some of the major problems confronting the preschool child and his mother are remarkably similar from one country to another, there cannot be a single solution applicable to all developing countries. This is the subject matter of the fifth section; topics such as the importance of breast feeding, home and commercial production of locally appropriate food mixtures and their use for feeding the vulnerable groups and nutrition education of families are discussed. FAO, WHO and UNICEF have launched several programmes towards this end, such as applied nutrition programmes, development of indigenous protein-rich foods and their human testing and market trials, and organization of training programmes for various levels of nutrition workers.

The last two sections are concerned with the "protein gap" and the efforts to "bridge" it. The great differences between protein supply and demand in developing countries call for urgent action to increase production of protein-rich foods. The traditional agriculture in these countries should be modernized, research in plant breeding should be intensified to develop food crops of higher protein quality and greater yield and better and more economical use of oilseeds should be encouraged to make them safe and high-quality foods. At the same time attention should be paid to development of the dairy industry, breeding programmes for improvement of meat and dairy cattle, pigs and poultry, eradication of disease pests and development of animal feed. The exploitation of additional food resources from the sea and other new protein sources and development of single cell proteins to make them suitable and acceptable for human consumption also call for urgent attention. It is heartening to note that advances have been made in each of these fields though much remains to be done. The above attempts, while helping to "bridge the protein gap", should be accompanied by the development of safeguards to prevent losses and insure proper and equitable distribution.

Food and Agriculture Organization of the United Nations. 1970. Lives in peril - protein and the child. FAO, Rome, Italy. 52 pp. Available in English, French and Spanish; English edition out of print.

PSV

Ming-yu Li:

THE NEED FOR DOCUMENTATION SERVICES IN THE FIELD OF PROTEIN FOODS DEVELOPMENT

A study carried out on behalf of the PAG concludes that consideration should be given to aiding appropriate centres and workers in gaining access to abstracts which are being published and which have relevance to protein food and protein nutrition. Presently, these are often not available for economic reasons. Also, it is considered worth exploring extending the coverage of the PAG Bulletin, which should give information on most recent developments in the protein food field, especially such subjects or activities which are not normally covered by other publications.

One important aspect of furthering developmental work designed to improve protein nutrition is to make certain that those working in this area have adequate access to relevant data. The Agencies sponsoring the PAG have supported a study in this field, assisted by Dr. Ming-yu Li, Food Protection and Toxicology Center, University of California, Davis, Calif., U.S.A., acting as a consultant. In cooperation with the PAG Secretariat, Dr. Li prepared a report which was presented at the 17th Meeting of the PAG in May 1970.

Dr. Li first visited some centres which are active in this field, in areas where extensive library and documentation services are not readily available. Dr. Li visited the Nutrition Institute for Central America and Panama, Guatemala City, Guatemala, the Caribbean Food and Nutrition Institute, Kingston, Jamaica, and the Central Food Technology Research Institute in Mysore, India. These visits and information from many other centres indicated that there is indeed a need for improved services in this field.

Subject areas

Some of the subjects where better access to existing data are needed are as follows:

General: Food habits; nutritional surveys; acceptance of foods; utilization of protein foods, economics of protein foods; marketing; statistics of protein production; social and economic consequences of foods designed to imitate traditional foods; influence of religious beliefs; profile of traditional food items; and practicability of protein foods.

Technical Aspects: Quality of proteins; retention of proteins in prepared foods; composition of protein foods; protein losses during cooking and preparation; processing and production; protein food product developments; processing details; new protein foods; high-protein foods (bakery products, beverages, etc.); distribution; packaging.

Agricultural Aspects: High-yielding varieties; breeding results of high-protein varieties; grain storage; prevention of food losses due to insect infestation, microorganisms; new sources of proteins.

Safety: Effects of toxins and pesticides; food laws; labelling of protein foods; feeding tests on animals and humans; efficiency and safety of food substitutes.

PAG Bulletin

One of the findings was that there is a need for rapid dissemination of information which is presented at the PAG meetings. It appeared that the PAG may be in a good position to disseminate information about available reports and data on protein foods. One important information medium may be the PAG Bulletin. It was proposed that in the future this Bulletin give more information on the sources of raw materials, such as grains, legumes, oilseeds, animal proteins, and nonconventional sources of proteins. It was considered that the Bulletin could be published on a quarterly basis and that it should give information on trends in protein foods development and review the successes and failures of various new protein foods. It might also give abstracts or summaries of papers before or after a symposium or conference on protein foods is held and could give summaries of the papers presented at PAG meetings and information not available in the published literature. It should also attempt to summarize results of tests on protein food products.

Abstracts

The majority of the scientists, librarians and documentalists interviewed indicated that a documentation service in the protein food field would be a very useful aid. It was fully recognized that several abstracting journals are already available. Particular reference was made to "Food Science and Technology Abstracts" which has been published since January 1968. It covers 1,100 serial publications and published 1,200 abstracts in 1969, of which approximately 400 were concerned with edible proteins. Reference was also made to "Nutrition Abstracts and Reviews" prepared by the Commonwealth Bureau of Animal Nutrition in the United Kingdom; it published about 1,500 abstracts and titles in 1969, of which 400 were concerned with nutritional aspects of protein foods.

Reference was further made to "Chemical Abstracts" which covers more than 12,000 periodicals; of the approximately 250,000 abstracts published annually, three to four hundred relate to the chemical aspects of protein foods. Similarly "Biological Abstracts" covers approximately 8,000 primary publications and published about 135,000 abstracts in 1969; of these about 600 were related to protein foods.

Some abstracts are also given in a new journal "Plant Foods for Human Nutrition" (Abstracts Section). In the first volume of this journal, the total number of abstracts was 231.

Reference was further made to the "Journal of the Science of Food and Agriculture" (Abstracts Section). In 1969, this journal had approximately 100 abstracts on protein foods.

The study also referred to the "Food Technology Abstracts" published since 1966 by the Central Food Technology Research Institute in Mysore, India. It is an in-house monthly publication designed primarily for the Indian Institute itself, government agencies, agricultural colleges, industries and experiment stations. It covers approximately 125 journals and reproduces about 2,000 abstracts per year.

Finally reference was made to the FAO Documentation Current Index, which is a computer-generated index prepared by the FAO Documentation Centre in Rome, Italy, to make readily available information contained in FAO publications and documents. It processes about 5,000 documents annually and has approximately 25,000 documents in its data base.

Most of the scientists interviewed indicated that the chief obstacles were lack of funds to pay for subscriptions to the necessary abstract journal, and a lack of trained personnel to collect, consolidate, and disseminate the information. Lack of time for the scientists and technical workers to read and scan all the relevant literature was also cited. There was a certain lack of awareness of the existence of publications and lack of access to them. It was often found that where information was available in a central library, the workers on specific projects found they had no time to scan the wealth of literature available.

It was also felt that there was a considerable lack of access to information between countries, due either to lack of effective communication or to language barriers. Finally, it was found that many reports issued by government agencies, international bodies, and industrial laboratories are not generally available and therefore not known.

One administrator summarized the situation as follows: "There are many journals and books relevant to all our fields of interest. Unfortunately, we do not have the funds to subscribe to all of them. Even if we did have the money, we would not have 1) the time to read them all and 2) the trained personnel to organize the information in a form that we could easily absorb."

The report concludes that there is a considerable amount of documentation and abstracting service available in the world. However, the information is found in rather generalized services and each person working in the protein food field has to scan a rather considerable amount of abstracts or references in order to find the desired information. In addition, access to these services is quite expensive; a subscription to "Food Science and Technology Abstracts" is $195 annually, and a subscription to "Chemical Abstracts" is $1950 annually. It was proposed, therefore, that means be investigated to establish a collaboration between some of the existing services in the field with a view to establishing a system whereby abstracts particularly related to aspects of protein foods and protein nutrition could be made available separately. One might consider starting with the abstracts published in "Food Science and Technology Abstracts", "Nutrition Abstracts and Reviews", and "Food Technology Abstracts".

The proposed service should provide rapid access to current information on protein foods and protein nutrition obtained from worldwide information sources. It should also give adequate coverage of social, economic and agricultural aspects. It should provide for prompt photocopying of the original article on request and it should be able to carry out retrospective searching. Once the service is under way, it should also consider the easy conversion of the input data into machine - readable form.

The PAG Bulletin should provide reviews of topics of current and long-range importance and should give a synopsis of PAG Meetings and other worldwide conferences and symposia on protein problems.

It should give information regarding the availability of reports and publications issued by local government agencies, international organizations, academic institutions, industry and private research laboratories. It should also give book reviews and list future meetings and it should at least consider giving summaries in the working languages of the United Nations.

Referral Service

It was proposed also that the PAG should encourage the establishment of a referral service. This should be able to refer interested persons to existing translations of articles in the protein food field. On specific subjects, it should also be able to refer to specialists to whom inquiries might be directed.

Periodic Evaluations

If any of these recommendations are adopted the report concluded that a periodic evaluation of the efficiency of the service be carried out.

Li, Ming-yu. 1970. A report on the need for documentation services in the field of protein foods development. PAG, United Nations, New

York, U.S.A. 37 pp. Mimeographed. PAG document 1.4.4/1. Out of print.

NUTRITION EDUCATION FILM FROM INDIA

The Protein Foods Association of India has produced a popular film advocating improved protein nutrition for children. The film will be shown widely in India.

The PAG has received from the Protein Foods Association of India a 16mm print of a film entitled "Horoscope for a Child" (English version). It tells a story of an Indian family. The father is a taxi-driver and his income permits a diet which seems satisfactory. However, something goes wrong with the children, who are showing early signs of malnutrition. The film explains the importance of dahl, eggs, meat and milk for the health of the child. If the diet does not contain these ingredients, the child's future may be jeopardized, due to retarded physical and mental development. The child's plate is his horoscope.

JHJ

WHO:

THE HEALTH ASPECTS OF FOOD AND NUTRITION

A manual for developing countries in the Western Pacific Region of the WHO.

The manual has been prepared to provide an adequate background on the subject of nutrition to all health workers and particularly those working in developing areas of the Western Pacific Region. It is written in such simple style that it will be useful not only for physicians but also for other categories of health, nutrition and extension workers dealing with various aspects of nutritional problems and their solution.

The book begins with a general survey of climatic, agricultural and socioeconomic factors influencing the diet and food habits of the people of the region. It includes a brief account of the principal foods in the area and their nutritive value. A short description of the various nutritional disorders seen in the region, with clinical photographs, follow along with guidelines for treatment of these disorders. The dietary intake and nutritional status of vulnerable groups are discussed including the do's and dont's of child feeding. There is a useful section on how to correct existing defects within the available means. There are detailed chapters on nutrition surveys, nutrition education and supplementary feeding and food hygiene and standards.

The administration and coordination of, and training for, nutrition activities and nutrition programmes of the region are described in separate chapters. The appendices, which make up nearly 40 percent of the manual, contain information valuable to all nutrition workers. There is an extensive bibliography covering almost the entire world literature on nutrition for the last two decades.

World Health Organization, Western Pacific Regional Office. 1969. The health aspects of food and nutrition. WHO, Manila, the Philippines. 380 pp.

N. W. Pirie:

FOOD RESOURCES - CONVENTIONAL AND NOVEL

Two current problems of the world are population explosion and food insufficiency. Though both are interrelated and food supplies can never catch up with unrestrained population, conception control by itself cannot be considered an approach to the problem of food shortage. There is urgent need to not only increase agricultural production but also explore and develop new methods of producing food.

The theme of this interesting book is a call for more food production both by applying existing knowledge more effectively and organizing large-scale research to evolve procedures whereby more food could be produced in places where it is needed using local resources. Intensification and modernization of conventional agriculture will alone make a great contribution though there is scope for further research at many points. While these are hopeful signs, it is doubtful whether a mere increase in conventional crops will meet the world's needs. These crops, without supplementation, are not always nutritionally adequate especially with regard to protein. The author discusses several new possibilities for obtaining more food and extending its range and quality by adoption of suitable bioengineering techniques. He stresses the importance of research at every stage and indicates the expectations and difficulties all along the way.

N. W. Pirie. 1969. Food resources, conventional and novel. Penguin Books, Baltimore, Md., U.S.A. 208 pp. $1.25.

FAO:

FIVE KEYS TO DEVELOPMENT

This booklet, published by FAO as a prelude to the World Food Congress, identifies the five crucial areas for priority effort which, according to FAO, are the five keys to progress and development.

The crucial areas are reduction of waste, closing the protein gap, promotion of high-yielding cereal varieties, earning and saving foreign exchange, and maximum utilization of human resources. Separate chapters give a detailed account of the several problems to be faced in each of the above areas. The book describes the numerous difficulties that must be surmounted, analyzes the new problems that current plans and programmes are creating, focusses on the areas where intensive efforts are needed, and indicates the several ways in which FAO is providing guidance and help. Even in the most promising of projects, it is FAO's experience that unless all available skills are teamed from the beginning, a great many advantages will be lost.

Food and Agriculture Organization of the United Nations. 1970. Five keys to development. FAO, Rome, Italy. 44 pp.

ERRATUM

The review of "Single Cell Protein" by Mateles and Tannenbaum, which appeared in PAG Bulletin No. 9, pages 34 through 36, contains a factual error. It was reported incorrectly that Russian and Czechoslovak workers had noticed some evidence of tumors in animals fed yeast grown on gas oil. In fact, there has been no incidence of tumors in any of the feeding studies on SCP performed in either of these countries.

ATTA FORTIFICATION PROGRAMME IN INDIA

An atta fortification programme was inaugurated in Bombay, India, on 25 February 1970. Atta is a kind of wheat flour that is used extensively in India for preparation of the chapati.

The Indian Government recognizes the many obstacles to changing food habits and has accepted the principle of fortifying common food items with desirable nutrients as one of the several methods of overcoming nutritional deficiencies. Although most of the twenty million tons of wheat consumed in India every year is ground into atta in small, hand-operated grinders, nearly three million tons are processed by large roller flour mills. It is this latter quantity which is to be used in the fortification programme.

There are eight ingredients representing seven nutrients used in atta fortification, as follows:

Edible-grade groundnut flour (45-50% protein)	50kg
Vitamin A	9.2g
Riboflavin	1.38g
Niacin	7.6g
Thiamine	1.5g
Calcium diphosphate	800g
Iron (as ferrous sulphate)	96g
Calcium carbonate	800g

It was found that straight addition of these ingredients to atta resulted in a discoloration of the chapati dough and a slight greying of the chapati. This was attributed to a reaction between ferrous sulphate and the phenolic substances occurring in the cuticles of the groundnut flour. Preparation of a suitable vitamin-mineral mix was undertaken, in collaboration with Roche Products Ltd., to "cover" the iron salt in order to minimize direct contact with the groundnut flour. This was done by using edible starch as the coating agent. On adding the vitamin and mineral mix to groundnut flour and subsequently blending the complete premix with atta in the correct proportion, the discoloration problem was eliminated. The fortified atta was consumer-tested to check its acceptability and the results were entirely satisfactory.

The procedure laid down is to have the vitamin-mineral mix, manufactured by Roche Products Ltd., blended with groundnut flour at a selected flour mill in each city. This master premix is then distributed to other flour mills for straight blending with atta in amounts of five percent.

Although all the vitamins and minerals used carry the quality guarantee of a pharmaceutical manufacturer, groundnut flour has to be carefully tested. Oil mills supplying groundnut flour are required to send samples of each lot to the Food Ministry in New Delhi to be tested for aflatoxin levels. Only when these samples have been cleared are the lots dispatched to atta production centres. Testing facilities are being established by the Government of India (GOI) in Bombay, Calcutta and Delhi so as to decentralize testing operations.

Fortified atta made from approved raw materials is not held back from sale, but a daily average sample from each flour mill is nevertheless dispatched to New Delhi for analysis. Coding of finished product packages will enable the miller or the State Government to locate recipients of each day's production of each mill, if necessary.

As a first step, the GOI has planned to have all flour mills in the Bombay, Calcutta and Delhi metropolitan areas fortify their entire production of atta. The industry has responded enthusiastically to the project. The monthly production of atta in these three cities averages 3,000, 8,000 and 15,000 tons respectively. As Bombay involves the smallest quantity and has only four flour mills (as against twenty-three in Calcutta and eight in Delhi), it was selected as the first target city.

This would afford the GOI and the Food Corporation of India (FCI) better control over the initial course of the programme. Bombay is to be considered a test from which lessons can be learned without affecting large quantities of product. The programme will be extended to Calcutta and Delhi later.

The current cost of fortification is 3.5 paise per kilogram of atta. This represents a little over 4 percent of its retail price. Initially, the programme is to be wholly subsidized for up to five months in each city. Subsidizing a complete national programme of this nature would cost more than Rs. 30 million annually and clearly requires consumer financing through price increases. The most appropriate time for these costs to be passed on to the consumer appears to be at the time of the annual revision of procurement prices of wheat in April-May, when a revision is also made in the maximum prices of wheat products.

The atta fortification programme has had the advantage of centralized direction; it was the decision of the Government's Food Ministry and the State Food Department that all mills in a specific location must fortify their atta. Programme implementation responsibilities are assigned by the Food Ministry to the FCI. The FCI purchases the vitamin-mineral mix and groundnut flour, arranges for the preparation of the master premix and ensures its distribution to all designated flour mills.

The atta fortification programme was inaugurated in Bombay by the State of Maharashtra's Minister for Food and Civil Supplies.

FISH PROTEIN CONCENTRATE (FPC)

An abstract of a submission for approval to the Food and Drug Directorate, Department of National Health and Welfare, Canada. Regulations issued in 1970 by the Canadian Government are also included.

Approval is requested for FPC made from three families of food fish of major economic importance to the Canadian fishing industry. The submission includes detailed scientific data on composition, wholesomeness and nutritional value of the following representative species of these three families: whole herring, whole capelin, whole hake, cod trimmings and haddock trimmings.

The following specifications are being suggested for FPC made from either whole edible fish or the trimmings of food fish.

Raw material: Only fresh fish may be used in the manufacture of FPC.

Process: The process is based on the extraction of water, lipids, etc. with isopropyl alcohol. Sanitary conditions must be maintained throughout the manufacturing process.

Protein: No standard. It is expected that fish protein concentrate will have a protein content of 65 to above 90 percent (N x 6.25), as determined by the Kjeldahl method for total nitrogen (AOAC 2.044, 10th Edition, 1965).

Lipids: Fish protein concentrate shall contain no more than 0.4 percent lipid as determined by extraction with chloroform - methanol (Bligh and Dyer, Can. J. Biochem. Physiol. 37: 911-917 (1959)) or by another procedure giving comparable results.

Ash: No standard. It is expected that fish protein concentrate will contain about 4 - 25 percent ash, as determined by the AOAC method (AOAC 18.008, 10th Edition, 1965).

Total volatiles: Fish protein concentrate shall contain not more than 10 percent total volatiles, i.e., mainly water and a small amount of residual isopropyl alcohol, as determined by the AOAC method(AOAC 23.003, 10th Edition, 1965).

Fluoride content: Fish protein concentrate shall contain not more than 250 ppm of fluorides (expressed as F) as determined by the AOAC method (AOAC 24.029, 10th Edition, 1965), or by another procedure giving comparable results.

Residual solvent: No standard. It is expected that fish protein concentrate will contain from less than 250 ppm to not more than 1.5 percent residual isopropyl alcohol when made under good food processing conditions.

Nutritive value: Fish protein concentrate shall have a PER not statistically significantly less than that of ANRC casein, when tested by the AOAC method (AOAC 39.133, 10th Edition, 1965).

Bacteriological count: Fish protein concentrate shall contain no E. coli, no Salmonella or other pathogenic organisms, and a total count of no more than 10,000 microorganisms/gramme as determined by APHA and FDA methods (Methods for the Microbiological Examination of Foods, American Public Health Association, 2nd Edition (1966) and U.S. Department of Health, Education and Welfare, FDA, Bacteriological Analytical Manual, April, 1966, Section 14).
It is recommended that levels of FPC up to 15 percent by weight of food as eaten be permitted.

The protein efficiency ratios of combinations of fish protein concentrates (identified as herring, capelin, cod frames, haddock frames, and freeze-dried cod) with whole wheat (WW) at levels furnishing equal amounts of protein, were determined by the AOAC procedure. Comparisons were made with a similar 50:50 mixture (on a protein basis) of casein: whole wheat and casein alone. The following PER values were obtained:

Casein	2.50
Casein + WW	2.32
Freeze-dried cod + WW	2.43
Herring + WW	2.40
Capelin + WW	2.38
Cod frames + WW	2.25
Haddock frames + WW	2.13

Studies to determine the toxicological safety of FPC made from hake revealed that substances toxic to rats and mice were not present in FPC and were not extractable in the solvents used. The evaluation of the safety of FPC was made in rats with abnormally high protein feeding levels with incidental high ash content. Nevertheless, aside from iron deficiency, no evidence of adverse physiological or pathological effects of FPC were disclosed.

Samples of fish protein concentrate produced by the Halifax Laboratory of the Fisheries Research Board of Canada have been examined for their fluoride content by six different laboratories. The results are shown in the following table.

Fluoride Analyses of Fish Protein Concentrate
(ppm)

Sample	Laboratory					
	A	B	C	D	E	F
Whole herring	126	125	153	155	123	175
Whole capelin	47	70	87	69	57	93
Cod frames	221	185	211	261	182	290
Haddock frames	252	205	227	218	307	350
Freeze-dried cod	120	95	112	-	-	170

The values reported by laboratory F tend to be higher than those of the other laboratories. While there is a definite consistency in the results for each type of FPC, the variations from the average range from 10-30 percent. When the rather numerous "inconsistencies" are disregarded, the variations can be reduced to ± 10 percent.

The low fluoride content of the FPC made from capelin shows that there is no direct relationship with the bone or ash content. The fluorides are, however, concentrated in the bones of fish, and it is assumed that the fluoride level is influenced by the feeding habits of each species.

Note on Canadian Regulations Relating to FPC

The Canadian regulations on FPC, to be issued in the fall of 1970, will contain the following provisions:

The following maximum contents apply

Arsenic	3.5 ppm
Lead	0.5 ppm
Fluorine	150 ppm

The protein content shall be not less than [illegible]. The protein shall be at least equivalent to casein in protein quality.

The product shall be prepared by extracting with isopropyl alcohol the water, fat and other soluble components from fresh whole edible fish of the order Clupeiformes, families Clupeidae and Osmeridae, and the order Gadiformes, family Gadidae, or from trimmings resulting from the filleting of such fish when eviscerated, and drying and grinding the protein concentrate resulting from this operation.

WORLD FOOD PROGRAMME (WFP) TO BOOST MILK, DAIRY PRODUCTION AND MARKETING IN INDIA

The United Nations/FAO WFP has approved a project costing nearly $56 million to help India expand her milk industry over a five-year period. The project will be concentrated in and around Bombay, Calcutta, Delhi and Madras, and will be entrusted to a national dairy development and finance corporation.

WFP will during the five years supply 126,000 tons of dried skim milk and 42,000 tons of butter oil to be reconstituted into liquid milk for sale in the four cities. This contribution will be phased so that it will be gradually replaced by local supplies. The reconstituted milk will be sold at a price which will not disrupt existing price structures. The money accruing from the sale of milk will be available to the corporation for use in the improvement of animal husbandry, fodder production, and development of milk transportation and storage facilities in a modern dairy network.

Milk is the most important source of animal protein in the Indian diet. At present, the dairy market is dominated by small private traders who retail a product which does not guarantee hygienic quality or freedom from dilution or adulteration. They cannot afford to improve their animals or their methods since they operate on too small a scale to make an adequate profit. The city milk schemes serve only a minor fraction of the total urban market. The urgent need for modernization and development of the dairy sector is stressed by the fact that in 1966 India had 229 million animals, including 52 million breedable cows and 25 million breedable buffaloes, with a milk production estimated at 20 million tons. However, only 140 grammes of milk per day per person are available, against a minimum daily recommendation of 280 grammes.

The social and economic benefits of the project should be widespread. The resulting modernized dairy system will stimulate greater production in rural areas by ensuring farmers a regular and stable market. It will discourage the slaughter of high-yielding milk animals and calves, and help to remove the cattle and cattle yards, which threaten public health, from the cities.

FOOD SCIENCE AND APPLIED NUTRITION CENTRE

A certificate course in food science and applied nutrition has been established at the University of Ibadan with assistance from UNICEF, FAO and WHO. A new building was donated by the Rockefeller Foundation.

In 1962, the University of Ibadan started a unit of Food Science and Applied Nutrition with the financial support of UNICEF and the technical assistance of other United Nations agencies, to run a joint certificate course with the London School of Hygiene and Tropical Medicine for the training of nutritionists from various parts of the developing world. This joint course, comprising four month's training in the United Kingdom, plus four months in Nigeria, was run every year from 1963 through 1967. During this period, over 120 nutritionists from 11 African countries, seven Middle Eastern countries, eight Southeast Asian countries, four Western Pacific countries, and three countries of the Americas, were trained.

In 1967, the Food Science and Applied Nutrition Unit was formed by the University of Ibadan to assume the entire responsibility for the certificate course, with concentration on the training of Africans.

The aim of the diploma course is to produce specialists in the fields of clinical nutrition, nutrition education, nutritional biochemistry, food analysis and other aspects of nutrition. It will help to produce the teachers required to start training units and departments in other African countries. Fellows attending are expected to return to their own countries to take charge of the nutrition aspects of major development programmes. Fellowships will be awarded by WHO, FAO, UNICEF and the countries proposing candidates.

RECENT PUBLICATIONS

Bender, A.E., R. Kihlberg, B. Lofquist and L. Munck (Eds.). 1970. Evaluation of novel protein products. Proceedings of the IBP and Wenner-Gren Center Symposium, Stockholm (1968). Pergamon Press, Oxford and New York.

Blix, G. (Ed.). 1969. Nutrition in preschool and school age. Symposia of the Swedish Nutrition Foundation VII. Almquist and Wiksell, Boktryckeri Aktiebolag, Uppsala, Sweden. 154 pp. $8.95.

Christensen, C.N. and H.H. Kaufman. 1969. Grain storage - the role of fungi in quality loss. University of Minnesota Press, Minneapolis, Minn., U.S.A.

De Silva, C.C. and N.G. Baptist. 1969. Tropical nutritional disorders of infants and children. Thomas, Springfield, Ill., U.S.A. 226 pp. $11.50.

Food and Agriculture Organization of the United Nations. 1967. Agriculture and industrialization. Basic Study No. 17. FAO, Rome, Italy. $1.50.

Food and Agriculture Organization of the United Nations. 1968. Nonprotein nitrogen in the nutrition of ruminants. Agricultural Studies No. 75. FAO, Rome, Italy. $2.00.

Food and Agriculture Organization of the United Nations. 1969. Bigger crops and better storage. The role of storage in world food supplies. World Food Problems No. 9. FAO, Rome, Italy. $1.00.

Food and Agriculture Organization of the United Nations. 1969. Toward a strategy for agricultural development. Basic Study No. 21. FAO, Rome, Italy. $1.00.

Food and Agriculture Organization of the United Nations. 1970. Marketing - a dynamic force in agricultural development. World Food Problems No. 10. FAO, Rome, Italy. $1.25.

Food Science Research Center. 1969. World food problems bibliography. 3451 E. Bellaire Way, Fresno, Calif. 93726, U.S.A.

Gyorgy, P. and O.L. Kline (Eds.). 1970. Malnutrition is a problem of ecology. Bibliotheca Nutritio et Dieta No. 14. S. Karger AG, Basel, Switzerland. Distributor in U.S.A.: A.J. Phiebig, P.O. Box 352, White Plains, N.Y. 10602. 224 pp. $6.50.

Houston, D.F. and G.O. Kohler. 1970. Nutritional properties of rice. National Academy of Sciences, Washington, D.C., U.S.A.

International Maize and Wheat Improvement Center. 1968-69. Annual Report. Londres 40, Apartado Postal 6.641, Mexico 6, D.F., Mexico.

Johnston, B.F. and J.P. Greaves. 1969. Manual on food and nutrition policy. FAO Nutritional studies No. 22. Food and Agriculture Organization of the United Nations, Rome, Italy. 95 pp. $2.00.

Library of Congress. 1970. Fish protein concentrate. A comprehensive bibliography. Washington, D.C., U.S.A.

McDivitt, M.E. and S.R. Mudambi. 1970. Human nutrition: principles and applications in India. Prentice - Hall of India, New Delhi. Available in U.S.A. from Prentice - Hall International, Englewood Cliffs, N.J. 07632. 192 pp. $1.50.

Muralt, A. von (Ed.). 1969. Protein-calorie malnutrition. The proceedings of a symposium sponsored by the Nestlé Foundation and held in September 1968 in Switzerland. Springer-Verlag, Berlin and New York.

Protein Foods Association of India. 1969. Food habits survey in Gujarat and Maharashtra. Bombay, India. Mimeographed.

Rockefeller Foundation. 1969. President's review and annual report. 111 W. 50th St., New York, N.Y. 10020, U.S.A.

Swedish IBP Committee. 1970. Directory of food and nutrition research in Denmark, Finland, Norway and Sweden. Styrelsen for Teknisk Utveckling, Stockholm, Sweden, $3.00.

U.S. Department of Agriculture. 1970. Possibilities for cereal fortification in East Pakistan. Report of a study group in collaboration with USAID. Washington, D.C., U.S.A.

PAG STATEMENTS, GUIDELINES, AND DOCUMENTS AVAILABLE

PAG Statements

No.	Title	Date
2	PAG Recommendation on aflatoxin	1969
3	PAG Statement on the nature and magnitude of the protein problem	1969
4	PAG Statement on single cell protein	1970
5	PAG Recommendation on marketing	1969
6	PAG Statement on milk substitutes	1970
7	PAG Recommendation on prevention of food losses and protein calorie malnutrition	1969
8	PAG Statement on plant improvement by genetic means	1969
9	PAG Recommendation on amino acid fortification of foods	1969
10	PAG Statement on a systems approach to the formulation and evaluation of nutrition intervention programmes	1970
11	PAG Statement on leaf protein concentrate	1970
12	PAG Statement on research and development areas	1970
13	PAG Statement on assistance to governments in formulation of a national food and nutrition policy	1970

PAG Guidelines

No.	Title	Date
1	Solvents for use in defatting oleaginous food materials (under revision)	1960
2	PAG Guideline for preparing food-quality groundnut flour	1970
3	A revised biological assay for the detection of aflatoxin (under revision)	1964
4	PAG Guideline for preparation of edible cottonseed protein concentrate	1970
5	PAG Guideline for edible, heat-processed soy grits and flour	1969
6	PAG Guideline for pre-clinical testing of novel sources of protein	1970
7	PAG Guideline for human testing of supplementary food mixtures	1970

PAG Statements and Guidelines may be used and quoted freely. Copies may be obtained without charge from the FAO/WHO/UNICEF Protein Advisory Group, United Nations, N.Y. 10017, U.S.A.

Drafts

At its 16th Meeting in 1969, the PAG considered some drafts for possible guidelines as listed below. These are not official PAG documents but anyone interested in commenting on them may receive a copy from the PAG Secretariat.

No.	Title	Date
2.8/26	PAG tentative suggestions for fish protein concentrates for human consumption (Draft)	1970
2.36/2	Suggestions for the design and execution of field studies to evaluate measures for improving protein nutritional status (Draft)	1969

MEETINGS

August 12 to 14, 1970	TENTH DRY BEAN RESEARCH CONFERENCE Contact: C. Tucker, University of California, Davis or B. Feinburg, USDA, Albany, Calif., U.S.A.	DAVIS, CALIF., U.S.A.
September 20 to 23, 1970	INTERNATIONAL CONFERENCE ON THE SCIENCE, TECHNOLOGY AND MARKETING OF RAPESEED AND RAPESEED PRODUCTS General Chairman: A.M. Runcima, President, Rapeseed Association of Canada.	STE. ADELE, P.Q., CANADA
October 12 to 16, 1970	INTERNATIONAL DAIRY CONGRESS Contact: The Secretary-General, 18th International Dairy Congress, 47 Macquarie St., Sydney, N.S.W., 2000, Australia.	SYDNEY, AUSTRALIA
November 5 and 6, 1970	PAHO/UNICEF CONFERENCE ON INFANT FEEDING (Closed meeting) Contact: Dr. Roberto Rueda-Williamson, PAHO, 525 23rd St., NW, Washington, D.C. 20037, U.S.A.	BOGOTA, COLOMBIA
December 28 and 29, 1970	OILSEED PROCESSORS CHALLENGED BY WORLD PROTEIN NEEDS: SYMPOSIUM AT THE WORLD CONGRESS OF AMERICAN OIL CHEMISTS SOCIETY AND INTERNATIONAL SOCIETY OF FAT RESEARCH Contact: Dr. M. W. Formo, Cargill, Inc.	CHICAGO, ILLINOIS

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On the recommendation of the PAG, the sponsoring Agencies have established some *ad hoc* working groups to consider specific aspects of the work of the PAG. Their members are listed below.

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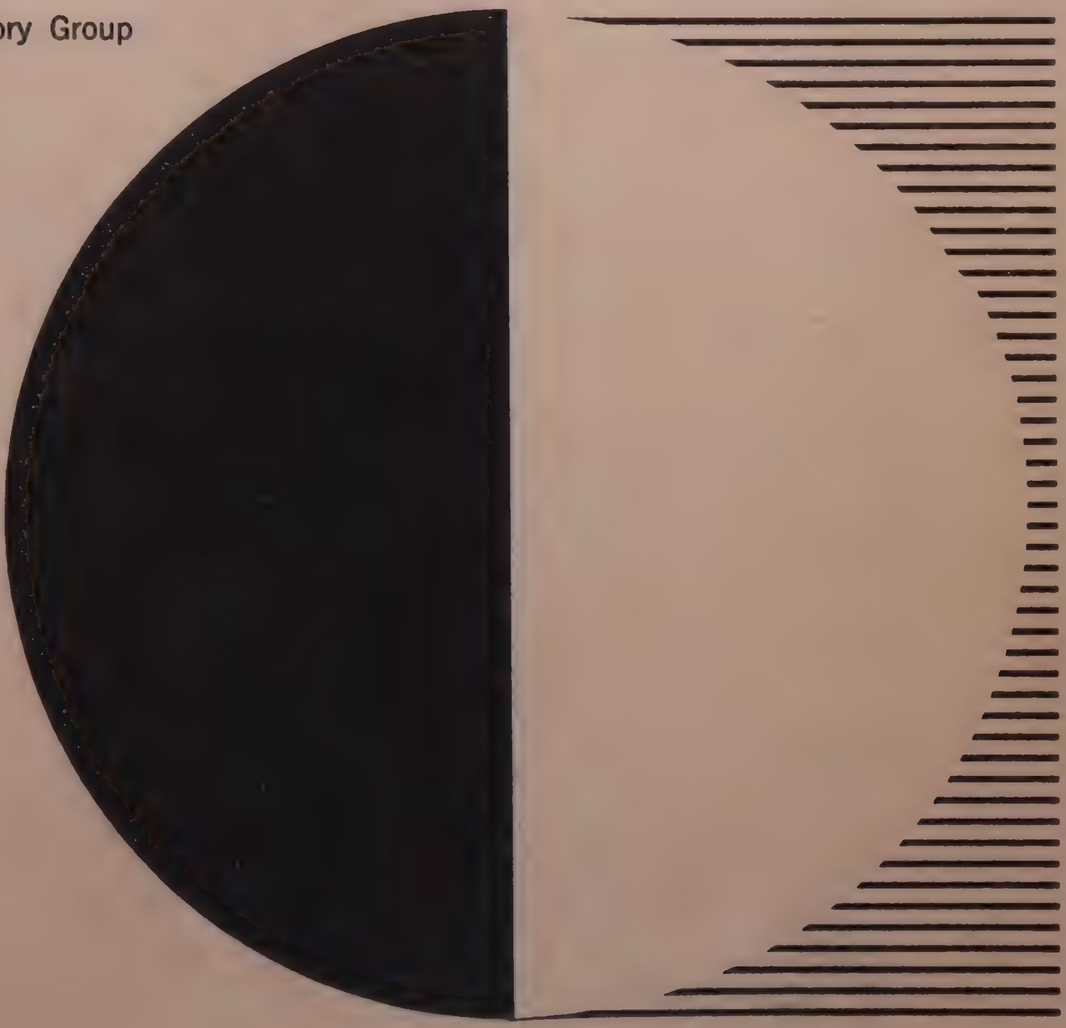

International review of action to improve world protein nutrition

ABOUT THE PAG BULLETIN

PURPOSE

The PAG Bulletin is published by FAO/WHO/UNICEF Protein Advisory Group. Its purpose is to give information on the world protein problem to those individuals, academic institutions, and industrial organizations who are interested in helping solve the protein problem, and to promote the exchange of information in this field.

MAILING LIST

The PAG Bulletin is sent without charge to persons, organizations and companies with an active interest in proteins. The present list comprises 2,500 names, about half in the U.S.A. and half well-distributed through the rest of the world. Requests to be added to the mailing list for the PAG Bulletin should be addressed to the Secretary, FAO/WHO/UNICEF Protein Advisory Group, United Nations, N.Y. 10017, U.S.A.

QUOTING

Permission to quote items from the PAG Bulletin is not required except from authors of signed articles. The Secretariat of the PAG will appreciate being informed of quotations that are made from the PAG Bulletin.

SUGGESTIONS

The PAG Bulletin will be successful only if it reflects all aspects of the protein problem comprehensively and objectively. The Secretaria invites suggestions and ideas for broadening and deepening the scope of the PAG Bulletin.

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London, England

PAG AD HOC WORKING GROUP ON THE POTENTIAL OF FPC FOR DEVELOPING COUNTRIES

The Meeting discussed various types of FPC and made recommendations regarding specifications and guidelines for such products. A relatively high lipid content may be permitted in FPC's which have a definitely fishy odour and taste. Fluorine levels up to 250 ppm might be permitted. This would entail some technological advantages. At present, only solvent extraction methods are sufficiently developed for preparing bland FPC powders which can be incorporated innocuously into other foodstuffs, the so-called type A products.

The world fish resources which presently yield raw material for fish meal are most likely fully exploited at the moment and supplies in the future may diminish. There was optimism about unknown, untapped resources in various areas. However, new fishing tactics and skills might have to be developed before they can be tapped. The seasonal nature of fisheries results in not more than about 100 days of actual operation of processing plants per year.

A cost analysis of the various supplemented diets suggested that FPC of type A quality was not competitive with such protein sources as soya flour and peanut flour.

The PAG *ad hoc* Working Group on the Potential of Fish Protein for Developing Countries met at the Tropical Products Institute in London, England, 9 - 13 November 1970. Members of the Group were Mr. G. H. Elliot, Scotland; Mr. Erik Heen, Norway; Dr. R. Idler, Canada (not participating); Dr. John Liston, U.S.A.; Dr. Philip Spensley, England; Dr. Max Rutmann, Chile; and Mr. Harry E. Power (alternate for Dr. Idler), Canada Advisors, observers or consultants to the Meeting were Mr. Roland Finch, U.S.A.; Dr. A. C. Burd, England; Dr. George K. Parman, U.S.A.; Dr. J. W. Devanney III, U.S.A.; Dr. N. R. Jones, England; and Dr. M. L. Windsor, England. From FAO, Mr. L. Boerema, Dr. G. D. Kapsiotis and Dr. Rudolf Kreuzer participated. Present from UNDP was Dr. E. Nagelstein, Switzerland; from UNIDO, Mr. Kresimir Sepic; and from the PAG Secretariat, Mr. Mogens Jul.

On the second and third day of the Meeting, a consultation was held with industry representatives. These were Dr. S. M. Barlow, International Association of Fish Meal Manufacturers, London, England; Mr. Arnold Carsten, SNC Protein Consultants Ltd., Montreal, Quebec, Canada; Mr. Bruno Javorsky, Alfa Laval, Tumba, Sweden; Mr. Leif Knutson, Astra-Nutrition, Mölndal, Sweden; Mr. Gert Lóvold, Oslo, Norway; Dr. E. R. Pariser, Cardinal Proteins Ltd., Halifax, Nova Scotia, Canada; and Dr. Ettrup Petersen, Atlas, Copenhagen, Denmark.

Product

For purposes of discussion fish protein concentrate was taken to be a stable product, suitable for human consumption and prepared by a process involving the removal of water from whole fish or parts thereof. Conventional, ordinary dried or salted fish were excluded. Bland FPC of very low lipid content was designated type A; a product with some fishy taste but low in lipids was designated type B; and a product with a definite fishy taste and a considerable lipid content was called type C. It was agreed that where standards or guidelines for FPC are developed, a distinction between types B and C may not be desirable. Compositional guidelines for an FPC should be fairly flexible since development in this field is relatively new. As regards safety aspects, it was clear that all necessary safeguards would have to be met. The microbiological standards generally in use for dried skimmed milk were considered appropriate for FPC.

The nutritive value of the protein in an FPC should be comparable to that of casein. Since fluorine in fish protein concentrate is only partially available the permissible fluorine content might be increased to 250 parts per million. This would be very advantageous since it would permit the use of a wider range of fishes and eliminate the need for deboning.

The FPC manufactured by the solvent extraction process is a bland, light-coloured powder and probably the only one which at the moment fits the criteria normally associated with type A FPC. It tends to have a certain grittiness, due to the presence of fish bones in the raw material. This grittiness can be eliminated by grinding the material very finely. Its lack of functional properties may be an advantage in that it does not change the characteristics of the food to which it is added. It was considered that type A FPC can be added to bread in percentages of up to 3 per cent without any noticeable deterioration of the quality of the bread. In pastas it may be used in quantities up to 40 per cent. The product could be changed by alkali treatment or some other process so as to have water-binding capacities, etc. There is very little information available on the acceptability of various fish protein concentrates in the developing world and tests should be carried out in connection with various aid programmes, multilateral programmes, etc. There is need for development of standardized methods for testing FPC with regard to organoleptic and functional qualities.

Use

Since it is not always easy to reach the vulnerable groups who need protein, FPC may be used to supplement some basic staple. This is in general the simplest method but it may be relatively expensive because much of the supplementation may not reach the groups in need of added protein.

Production

A simple process similar to that used in fish meal manufacture might be the cheapest and acceptable for certain purposes. The solvent extraction methods are at the moment the only type of processes which are ready for commercialization. This process can be used for oily fish species as well as for lean fish species and yields a type A product. Methods are available for the manufacture of human-grade fish meal, which is subsequently extracted so that it has a very low fat content. This fish meal is considered suitable for human consumption where a characteristic fishy flavour and odour meet no objections. Also, there is a market for such a product in the animal feed industry. Another extensive operation involves a process where a human-grade conventional fish meal is manufactured and the meal pelletized immediately thereafter. It is then stored and extracted at some convenient time with hexane to a content of 0.3 to 0.5 per cent fat. The hydrolytic process uses deboned hake and a commercial enzyme to carry out the hydrolysis followed by pasteurization, evaporation and spray-drying. Hydrogenated fish oil or vegetable oil with an added antioxidant may then be added. The resulting product is like dried milk and seems well suited for infant feeding.

The use of modern Japanese deboning equipment eliminates the unattractive part of the fish cheaply and the yield rates could be about 1 to 8.4, when deboned eviscerated fish was used, compared to 1 to 6 for a whole fish process.

The use of high-grade, large-size fish for FPC may be uneconomical if a market exists for fresh or frozen fish. On the other hand, the catch may sometimes be of a low quality and suitable only for fish meal. The difficulty of obtaining a steady supply of raw material is another problem. The use of trash fish, e. g. from shrimp fisheries, is risky since such mixed catches may contain toxic species about which not too much is known. Exploration of new areas for fish catch and modernizing the catching methods may to some extent help in increasing the fish resources. These factors bring into focus the possibility of operating an FPC plant as a floating factory. This is presently being tested by a Swedish concern. Basing the operation on a floating factory will secure access to raw material over a longer period of the year. The plant may be scheduled to operate for up to 300 days per year and 24 hours a day. A floating factory has the advantage of always having fresh raw material and no pollution problems. However, both capital investment and operating costs of a floating factory are high, generally more than twice those of a similar land-based operation.

The possibility for developing various sophisticated FPC's with specific properties and textures costing up to US $1.00 per pound exists. These would have a high functionality and be useful in sophisticated food industries.

Economics

Based on computer techniques an attempt was made to present the cost analysis of a supplementation programme. The calculations suggested severe limitations as to the potential uses of FPC.

For an economic estimate one should calculate on the basis of a total number of days of operation of a plant of not more than 100 under most conditions and a high (35 per cent) return on investment. The economic sales price of type A FPC currently appeared to be of the order of 35 US cents per pound.

The Meeting drafted a statement which was considered by the PAG Meeting in February 1971.

Geneva, Switzerland

SECOND MEETING OF THE PAG AD HOC WORKING GROUP ON FEEDING THE PRESCHOOL CHILD

The PAG ad hoc Working Group on Feeding the Preschool Child held its second Meeting in Geneva, 14 - 18 September 1970.

Members of the Group present were: Professor Bo Vahlquist (Chairman), Sweden; Dr. J. K. Harfouche, Lebanon; Dr. F. Monkeberg, Chile; and Dr. A. H. Niehoff, U.S.A. Dr. A. Omololu, Nigeria, was a special participant. Advisers were Dr. A. Dahlqvist, Sweden; Miss M. E. Cameron, England; Miss Marina Flores, Guatemala; and Dr. Yngve N. Hofvander, Sweden. Representatives of WHO were Dr. J. M. Bengoa, Dr. E. M. DeMaeyer, Mr. G. Plouidy, Dr. A. Raba, and Dr. F. Rosa. Other groups represented were: FAO, by Dr. P. L. H. Davey; WHO/PAHO, by Dr. D. S. Jelliffe, Jamaica; UNICEF, by Dr. L.

J. Teply; and the International Children's Centre, by Professor Satge, France. Mrs. P. Jelliffe was an observer. Dr. O. Ballarin, Brazil, attended for the PAG, and Dr. P. S. Venkatachalam for the PAG Secretariat.

The extensive literature on nutrition in utero was reviewed to evaluate the effects of maternal nutrition status during pregnancy on the mother and the foetus, immediately as well as in the long range. It was noted that many observations made remained difficult to interpret because of the several interrelated factors influencing the outcome of pregnancy. The currently important question of the interrelationship between family planning and nutrition was considered, with special reference to the effect of repeated pregnancy on the health of family members and on the relationship between nutrition and family planning programmes.

The current knowledge with regard to nutrient requirements of infants and children was reviewed. The importance of fat in infant nutrition, disaccharides in infant and child feeding and current information on trace elements requirements were some of the other aspects touched upon.

The consequences of shortening the duration of lactation in less technically developed areas of the world were discussed and the factors responsible for this development and suggestions for preventive action against failure to breast feed were considered. The Group felt a need to obtain more information on current practices of infant feeding and trends, if any, in different parts of the world.

Similarly, the need for collecting data on food consumption of preschool children was stressed. The Group recommended the preparation of a manual on methodology of such surveys and training of staff to enable the development of uniform procedures.

A draft manual on feeding infants and young children, with emphasis on home-prepared weaning foods, by Dr. Hofvander and Miss Cameron, was reviewed and suggestions for a revision by the authors were worked out in detail. The revised manual is expected to be ready in early 1971.

The social, cultural and economic factors which influence child feeding patterns, the principles governing the organization and development of different communications channels and the extent of their influence on the mother, family and the community were discussed. The current experience with the operation of a few preschool protection programmes was described.

With regard to disaccharidase deficiency, the Group felt that further studies are required to assess the public health significance of the problem. The importance of combined action against malnutrition and infectious diseases was stressed once again. The other subjects discussed were preschool child feeding in times of disaster and experience with the use of special mixtures for treatment of PCM.

A combined technical report covering the two meetings of this Working Group will be issued by the PAG in 1971.

CHANGE IN SECRETARIAT

Mr. Mogens Jul, Secretary for the past two years, left the PAG on March 1, 1971, and has returned to his native Denmark. Dr. G. D. Kapsiotis of FAO, Rome, assumed charge of the post of Secretary beginning on March 17, 1971.

Rome, Italy

MEETING OF THE PAG AD HOC WORKING GROUP ON MARKETING

The Meeting recommended that definite steps be taken to organize training in the field of marketing. There is need for marketing planners, marketing managers, and sales and promotional personnel. The more general courses may be given on a regional basis, the others at a national level. The Group also recommended that one or more research centres should be established, which would collect information on experience in the marketing of protein-rich foods and periodically publish such information in the form of case histories. Such centres might also enter actively into experimenting with different marketing approaches. The Meeting concluded that more interest should be given to institutional feeding as an outlet for protein-rich foods and recommended to the PAG that it should give increased attention to measures to improve marketing of conventional protein foods. The Working Group felt that the PAG should give increased attention to the types of enterprises best suited for marketing protein-rich foods. The Meeting finished the consideration of a draft for a guideline on marketing of protein-rich foods. The Group's recommendations were considered at the 18th PAG Meeting in February 1971.

The PAG *ad hoc* Working Group on Marketing met at FAO's Headquarters in Rome, 2 to 5 November 1970. Members of the Group present were: Dr. Sidney M. Cantor (Chairman), U.S.A.; Dr. N. H. Neyzi, Turkey; Dr. V. N. Patankar, India; Professor Bo Wickstrom, Sweden; and Professor P. von Blanckenburg, Berlin. From FAO, Mr. J. C. Abbott, Dr. G. D. Kapsiotis, Mr. H. J. Mittendorf, Mr. I. Ozorai, and Mr. N. A. Wilkie participated. The PAG Secretariat was represented by Mr. M. Jul.

Marketing guideline

For the Meeting, Professor Wickstrom had prepared a draft for a guideline to be used in marketing of protein-rich foods. The Group reviewed this draft in detail and approved a slightly revised version for submission to the PAG. This document will be published as a PAG Guideline.

The Group agreed that the guideline would be useful in designing marketing strategies for protein-rich foods in developing countries and that it might also be used as a guide for marketing of other foods.

The value of incorporating specific case studies in the marketing guideline was appreciated, especially in its use as a tool for training personnel. Nevertheless, it was agreed that inclusion of such case studies will not be practical since such examples quickly become obsolete due to constantly changing situations. It was suggested that the PAG Secretariat may obtain such case histories and publish them as PAG documents.

Training

The Group considered that the nonavailability of trained personnel is one of the biggest obstacles to any marketing scheme in developing countries.

The Group considered the training of what might be called a nutrition operator or nutrition programmer. The candidates for this will at least be graduate students who will obtain an overall picture of marketing problems and nutrition subjects to qualify them to assist in the formulation of broad strategies in the area of food and nutrition intervention. Additional training will include psychology, sociology, advertising, etc.

The Group identified a need for training of marketing managers to be in charge of specific protein-rich food projects. With regard to middle marketing managers, the training should be preceded by some experience in the food marketing field. They will receive three weeks of formal training, three weeks of field work, and then return to the education centre to discuss and digest the field experience.

The need for training at lower levels of sales and promotion personnel was emphasized. Training of such persons should be tailor-made to the specific project and would probably be done at the national level.

Finally, the Group identified a need for training managers of institutional feeding programmes.

It was suggested that the efficient marketing training programmes which large corporations have should be effectively used for this purpose. Trainees might attend such formal marketing training rather than learning the work in the field by being volunteers in marketing schemes. It was the experience that guidance of such volunteers required a large investment in time from those with whom the volunteers were working and most organizations were hesitant to accept them. However, where government programmes are concerned, it would be useful if a specific component of the programme could be to provide for such trainees.

The Group expressed the hope that some bilateral agency or foundation might be interested in setting up such marketing training schemes as outlined by the Group. The Group agreed that once the personnel is trained, it is necessary to look after its needs for continued training.

It was found that all training should be specifically market-oriented and should be done in an atmosphere of actual marketing needs and urgency and not in an academic atmosphere.

Since lack of trained personnel is a bottleneck in marketing schemes, serious consideration should often be given to the use of some existing marketing system in preference to establishing a new one for protein-rich foods. An example was mentioned of one country where a pharmaceutical company would undertake the distribution of a new protein-rich food simply because that company already had a distribution system and a considerable number of persons with experience in marketing.

Research

The Group thought that it would be useful to establish some centres which would undertake descriptive marketing research. They would collect information on experience gained in the marketing schemes for protein-rich foods. The Group deplored the fact that "aid has no memory"; aid to developing countries is often carried out by specialists who come to the countries on brief assignments. While some of their formal action is written up in reports, most of the real-life experience gained is lost when the specialists leave the country. Even the supporting personnel in the nation or international organization may change, so that often all the experience is lost. For this reason it is of particular importance that research centres be active in the field of recording what is actually taking place so that the experience can be utilized in new schemes.

The Group also considered it useful to set up centres which would carry out actual experimentation in the field of marketing. They should be able to work with existing marketing schemes and have funds available for trying various approaches to the marketing process.

Institutional feeding

The Group agreed that institutional feeding programmes ought to be important outlets for protein-rich foods. This would have to be planned carefully in order that such programmes would not adversely affect the commercial distribution. Distribution cost is generally high in institutional feeding and almost prohibitive when it comes to the distribution of hot foods. In general it appears that the benefits obtained from institutional feeding are not well known. It was recommended that this be studied further by both FAO and the World Food Programme.

Structure of enterprise

The Group had before it a note describing the various types of structures used in some of the protein food marketing schemes with which FAO had been connected.

In general, the Group realized that in this new field of marketing, fresh approaches to enterprise structure would often have to be used. The Group deplored the fact that governments often had difficulties or even some hesitation in working with private industry. Private industry often had active distribution systems and experienced personnel which could be used even in schemes where, for instance, production would be a government undertaking. However, various sentiments and opinions exist in this field; the Group recommended that this be a subject for further study, possibly by the PAG. As one example, the Group mentioned the case where a dairy cooperative in India does the purchasing of the milk from the farmer and its processing, while the distribution of the milk, including marketing and advertising, is in the hands of the private sector.

The Group mentioned that it is particularly difficult to sell protein-rich foods to institutions, since in most countries each institution has its own purchasing arrangement. It would be very helpful if countries would adopt some universal system of institutional purchasing insofar as public institutions are concerned.

It was proposed that consideration be given to including marketing schemes for protein-rich foods in the activities of national marketing boards for agricultural products. Such marketing boards exist in many countries and generally have quite considerable funds which could be used to finance such ventures.

Marketing of conventional foods

The Group stressed that the concept of marketing in the edible proteins field had concentrated mainly on improved marketing of protein-rich foods. It was, however, equally important to improve marketing of conventional foods which are the major suppliers of proteins in all parts of the world.

The Group again stressed the need for making governments more aware of nutritional problems and the need for development of a national nutrition policy.

SINGLE CELL PROTEIN

At its 17th Meeting in New York, May 1970, the PAG adopted a revised and much extended statement on the prospects for the use of single cell protein (SCP), PAG Statement No. 4.

Although the use of yeast in food and animal feed is a common practice of long standing, only during the last few years has the potential of single cells as a source of protein been recognized. Single cell protein (SCP) has become, by definition, a generic term for crude or refined sources of protein whose origin is unicellular or simple multicellular organisms, i.e. bacteria, yeasts, fungi, algae and perhaps protozoa and even bacteriophages. The value and safety of several types of SCP for animal feed has been well established and the immediate concern of the PAG is with conditions under which SCP suitable for food use may be produced.

The raw materials include molasses, various sources of starch, sulphite waste liquor, whey, cellulose, and agricultural waste. However, worldwide attention is being paid to processes which use hydrocarbons or their derivatives as the sole energy source for growth of the microorganism. Most of this work is being done with gas oil, refined paraffin fractions, alcohols or natural gas.

All classes of microorganisms can be considered a potential source of protein if they are capable of meeting the criteria of safety, nutritive value and economics. Organoleptic properties and feed and food uses are also factors of importance. Extensive nutritional and toxicological investigations have been completed on a variety of forms of SCP. The data so far collected indicate that the several types of SCP grown in purified petroleum hydrocarbons are safe and possess considerable nutritional values. These parallel the similar favourable results with yeasts grown on molasses, sulphite liquors and vegetable wastes.None of the SCP materials or extracts from them, when appropriately tested in experimental animals, has shown any carcinogenic or mutagenic effects. However, a limiting factor in the intake of SCP is the relatively high concentration of nucleic acids present in the cells. Fortunately there are a number of processes available for lowering the nucleic acid content of intact cells to a point where this is no longer a limiting factor for food use.

It should be noted that the specifications and controls are more stringent when SCP is produced for human consumption than when it is used for animal feed. The terms used in the definition of substrates should be precise and the variables in the production process should be strictly controlled. It is essential to undertake extensive and properly-designed toxicological testing in several species of experimental animals for periods of time sufficient to detect cumulative toxicity and the presence of carcinogens. Appropriate biochemical and biological evaluation of nutritive value and microbiological testing for purity should be undertaken. The guidelines for doing so have been laid down in PAG Guideline No. 6 "Pre-clinical testing of novel sources of protein". Even the use of new SCP sources in animal feeds should be preceded by similar testing to ascertain that such materials do not render unsafe the milk, meat, etc. of such animals used as human food. Only when all these results are favourable should clinical testing be carried out. (PAG Guideline No. 7 "Human testing of supplementary food mixtures").

The price of SCP depends upon several factors and must be determined for each locale and substrate. Some of the important technological factors to be taken into account when examining the feasibility of SCP production on petroleum hydrocarbons are the location and size of the proposed plant and its capacity, cost and availability of substrate, and intended end use of SCP. In view of the above, the feasibility of SCP from petroleum hydrocarbons for developing countries will require careful evaluation.

It is strongly recommended that research on various aspects of SCP production and use as discussed above be undertaken.

MALNUTRITION AND SOCIOECONOMIC DEVELOPMENT

by Dr. Fernando Monckeberg Barros, Director, Laboratorio de Investigaciones Pediatricas, Escuela de Medicina, Universidad de Chile, Santiago

The consequences of malnutrition in a developing country are analyzed. The facts presented suggest that malnutrition is perhaps the most difficult and serious problem to be solved before a real start can be made in socioeconomic development.

"At present two-thirds of the world population are undernourished."(9), with disastrous consequences, a reality which affects not only those directly concerned but also handicaps and delays the advance of society as a whole. The damage done is so serious that it can be affirmed that socioeconomic advance is practically impossible while this state of affairs continues. In the present article an attempt is made to explain the reasons justifying this assertion with the aim of arousing consciousness of the problem and encouraging a search for rational technical and scientific solutions.

Whenever malnutrition is found in any social group the children are those most seriously affected. They are dependent on other persons for their food and these do not always have the sense of responsibility, education, knowledge or economic resources necessary to fulfil this task. Furthermore, children have greatly increased and specific nutritional needs, since their bodies constitute a metabolic machine working under high pressure. For example, a newborn baby doubles its weight during the first five months of life and trebles it by the end of the first year; in comparison, the adult merely needs to maintain an already fully-developed organism. Consequently, any nutritional restriction in children rapidly becomes evident, affecting the rate of growth and development both physically and mentally(12).

In recent years, surveys have been carried out with the purpose of assessing the nutritional status of adults and children in different parts of Chile (5, 10, 15, 18). The results show that at one year of age almost 30 per cent of children in Chile suffer from varying degrees of malnutrition. This number steadily increases, reaching 60 per cent at seven years of age, then remains stationary during the first school years, and falls steeply in adults. An objective way of determining the effects of chronic malnutrition is the simple measurement of the height of the child in relation to his age, since malnutrition leads to a decrease in the growth rate. Compared with the average found in the Chilean middle class, with better social and economic conditions, the children belonging to marginal population groups show a difference of almost 20 cm in height at seven years of age.

Malnutrition and disease

In Latin America half the children born die before 15 years of age, while in the United States this proportion is only six percent(24). This situation is due largely to malnutrition, which weakens the mechanisms of adaptation and defence, leaving the body vulnerable to the environment. Infection and malnutrition have effects which are synergistic (20). It is frequently observed that infections elicit and aggravate malnutrition while, in turn, malnutrition predisposes to infection. Thus a vicious circle is set up, the result of which is a high number of premature deaths.

In the statistics issued by different countries malnutrition does not seem to be clearly established as a cause of death. It is so common that malnutrition comes to be regarded as normal. Because of this, the death certificate makes mention only of the final cause of death, underestimating the underlying cause, which is always "chronic malnutrition". For example, in Chile until a few years ago, about 4500 children died every year from acute diarrhoea, according to the death certificates, and Yankauer and Ordway have estimated that about 250,000 children die from diarrhoea annually in Latin America (23). The real cause of these deaths is undoubtedly previous malnutrition, diarrhoea being only the final complication. Our experience shows that the acute dehydration caused by diarrhoea leads to a mortality rate of almost 30 percent among undernourished children, but only 2 percent when the children have been fed normally (13). The position in regard to other infectious diseases is somewhat similar. A typical example is that of measles, the mortality from which in Mexico in 1964 was 180 times greater than in the United States. In Guatemala, the mortality was 190 times, and in Ecuador 480 times greater (22). In a recent study a close and significant relationship was found between previous nutritional status and the course of measles (7). It was noted that those patients who developed complications and required lengthy hospitalization were undernourished children (7). The same thing was noted with the other infectious diseases, such as whooping cough, respiratory diseases, urinary complaints, gastrointestinal troubles, etc. (11, 19). The sum total of all these risks explains the high mortality rate observed during the first years of life in areas where malnutrition is common.

From an exclusively economic viewpoint, early death constitutes a heavy burden on society. The first stage of human life is nonproductive and involves considerable expense, both for the family and for society, which is repaid later on when the individual reaches the productive stage of life and is capable of returning to society that which he has received from it. Taka and Spiegelman (6) consider that this nonproductive stage extends on the average up to 18 years of age. They estimate that an American family, with an annual income of US$2,500, invests almost US$10,000 in a child during this period. The extent of the tremendous wastage that early deaths lead to in the developing countries can be realized from the above figures. Half the children born die within 15 years of age, before they have reached the productive period of life. Society invests enormous amounts of money on food, clothing, education, etc. with a low efficiency of return. These nonproductive expenses obviously constitute too heavy a burden for society as a whole and hold back economic development. Even countries with a sound economy would not be able to support a burden such as this, if we imagine a theoretical situation where they would have to double their investment during the nonproductive period while the output during the productive years of life remained the same. Our economies could survive simply because our countries do not invest these amounts; but for the same reason we are not advancing along the road to social and economic development.

Malnutrition and poor results of health investments

The members of the population who die prematurely, as a result of malnutrition, and those who succeed in surviving, both represent a very poor investment for the health services. The malnourished surviving child is frequently susceptible to episodes of disease and such children require continuous medical attention and hospitalization. In most of the underdeveloped countries, more than 90 percent of the children in hospital suffer from some degree of malnutrition. The diagnosis on admission to hospital may list one of the common childhood diseases, but the real and basic cause is chronic malnutrition. Everything spent on them for treatment is more or less lost; if it is effective and leads to an improvement in the condition of the child, this merely means the temporary survival of an undernourished child who will return to the same environment from whence he came and where malnutrition will continue to exercise its pernicious effects.

Undernourished subjects require periodic medical consultation and treatment which overloads the health services without producing any positive results. A recent cost study has shown that a child who suffers serious malnutrition in the first months of life and succeeds in reaching the age of 18 months, all the time with a varying degree of malnutrition, costs the National Health Service on an average, a sum of 15,000 escudos (about US $ 1000). The result of all this expense and effort is a distressing one, since in the end the child will die or, if he survives, will be permanently damaged both physically and possibly mentally.

Obviously the solution to the problem is not of a medical nature. The sums spent on curative medicine could be doubled or tripled without any appreciable progress if the primary causes persist. The figures are only too eloquent: in 1952, when the National Health Service was set up in Chile, the number of paediatric consultations was 40,000 per year and infant mortality was 120 per 1,000. In 1967, paediatric consultations had risen to almost 5,000,000 per year, but infant mortality was still 100 per 1,000.

In the case of Chile, the State is making an enormous effort, investing almost 17 percent of its budget in health, apparently without bringing about any fundamental change in the malnutrition problem. This problem overloads the health budget and at the same time the health measures taken yield poor results.

Effect of malnutrition on psychomotor development

There can be no doubt that malnutrition is the chief cause of premature death, but its effects on those who succeed in surviving, particularly with regard to mental development, can be disastrous.

There are sufficient experimental data to show the importance of nutrition in the development of the central nervous system. Persistent malnutrition affects the central nervous system as well as the other organs (3). It appears that the intellectual processes of synthesis, memory and abstraction correspond, from the biochemical viewpoint, to protein synthesis in the brain (8). In animals, a restricted diet which inhibits protein synthesis in various parenchyma also affects the brain (1, 4, 8).

It has been stated that in those low socioeconomic groups where malnutrition is prevalent there is a high frequency of delayed psychomotor development. Our own experience has confirmed this observation. Those groups having acceptable socioeconomic conditions show a low incidence of mental retardation (3 percent), similar to that in the more advanced countries. The difference is striking in less-favoured communities, such as the marginal population groups surrounding Santiago; 40 percent of preschool-age children have an intelligence quotient (IQ) of under 80, whereas the normal lies between 90 and 110 (16).

On the basis of present experimental data it can be affirmed that retardation in the physical development of these social groups is due beyond doubt to nutritional problems. However, we cannot be so emphatic in regard to retarded psychomotor development since many other factors are involved. The social groups suffering from malnutrition are precisely those which are outside society, with a very low educational level and depressing cultural and sanitary conditions. All these factors combine to form a "subworld" which restricts adequate stimulation for the development of mental abilities.

Investigations made in a closed marginal population group, where the environment was homogeneous, have shown that mental retardation is proportional to physical retardation (16). The latter, in turn, is a consequence of malnutrition (Figure 1). Furthermore, in the same population group there was a very significant relationship between the quantity of animal protein consumed and the extent of mental deficiency (Figure 2) (16).

During malnutrition not only does increase in height slow down but other physical measurements also decrease, among them the circumference of the skull (15). The skull of the undernourished child is smaller and the deficit in its growth is proportional to the degree of mental retardation (Figure 3) (16). The existence of this correlation seems to show that the nutritional factor has a considerable effect on intellectual ability, since it is difficult to accept that a slowing down in the growth of the skull is a consequence of environmental factors not connected with malnutrition (16).

The problem of mental deficiency affects not only children of preschool age but also adults. For example, measurement of the intellectual ability of mothers in the same marginal population group yielded alarming figures (Table 1) as compared with the Chilean middle classes; 77 percent of these women had an IQ of less than 80 (17).

Retardation in the mental development of adults is a serious barrier to applying any plan for preventing malnutrition. Thus there is a significant correlation between a low maternal IQ and the nutritional status of the child (Figure 4) (17). This is extremely significant, since it means that malnutrition not only leads to a low mental level but also that the latter aggravates malnutrition. This becomes a true vicious circle, which explains why malnutrition continues from one generation to another with few chances of an individual being able to escape from that condition.

All the circumstances described lead us to think that malnutrition _per se_ has a great influence on the low mental capacity of these economically weak groups. This fact is of extreme importance in the developing countries, in many of which more than 70 percent of children are undernourished and where the limitation of mental ability means an impossibility of speeding up socioeconomic development. A characteristic of the present century is scientific and technological progress which inevitably demands technically qualified persons at every level, which in turn means that the maximum is required from their intellectual potentialities. In Chile, for example, only 30 out of every 100 children who begin primary education complete it. In our view, and as shown by preliminary work now under way, this is due more to economic problems than to inability to learn. However, the consequence is that the majority of the underdeveloped people are prevented from expressing their whole genetic potential, since their environment cannot provide them with adequate nutrition and, in short, they are unable to participate in social and economic progress.

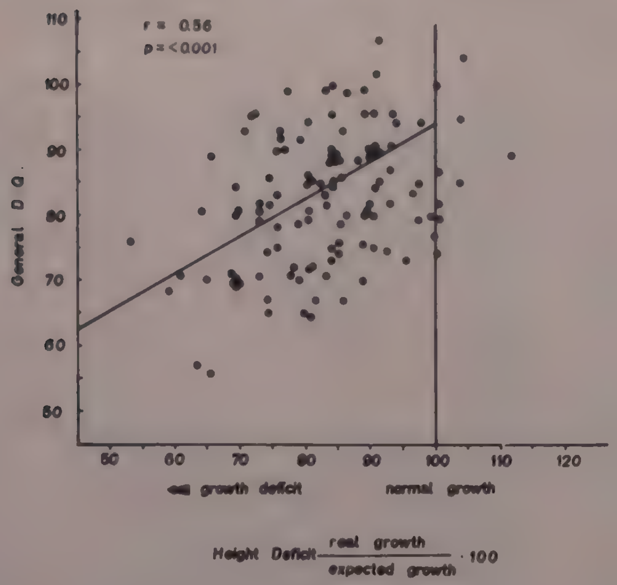
Existence of a critical period

Various studies made on both man and animals confirm that there really exists a critical period during the first months of life when the damage produced by malnutrition has more serious and permanent consequences, which persist even when environmental conditions improve later on.

The brain grows very rapidly during the first months of life and this is accompanied by active protein synthesis (21). At 18 months of age the brain has reached 80 percent of its final weight (3). It is logical to conclude that malnutrition during this period of rapid growth will produce severe and lasting lesions (14). In infants suffering from serious malnutrition, not only is the cranial diameter less but also definite cerebral atrophy develops, so that the brain is out of proportion to the skull. We have studied this by means of transillumination of the skull using a powerful 1,100-watt flash. In a normal child there is a

FIGURE 1

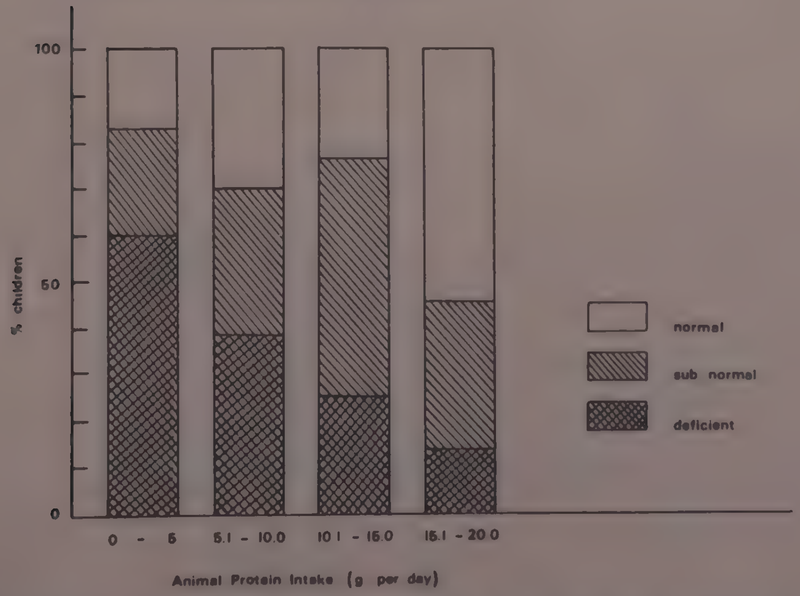
HEIGHT AND DEVELOPMENT QUOTIENT IN PRE-SCHOOL CHILDREN FROM 1 TO 5 YEARS OF AGE



Relationship between extent of retardation and growth rate in children from a marginal population group of Santiago

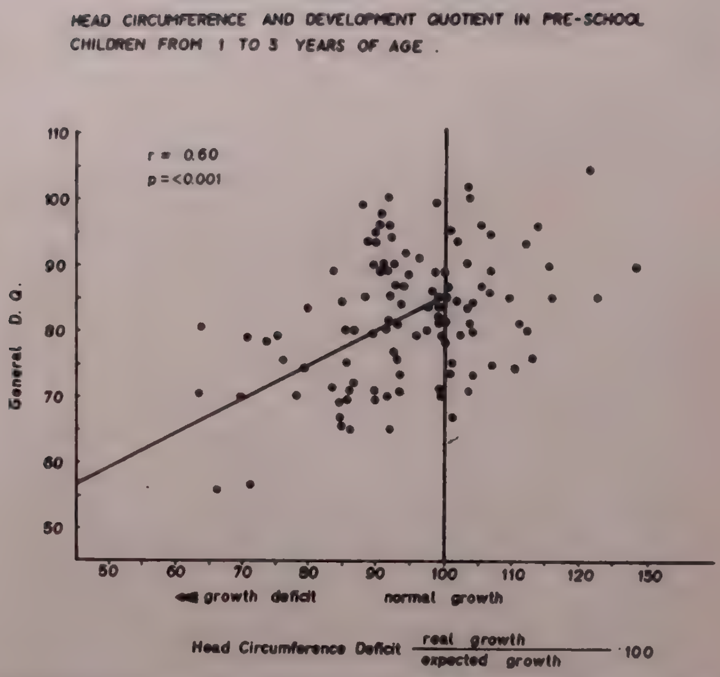
FIGURE 2

PERCENTAGES OF NORMALITY, SUB-NORMALITY AND DEFICIENCY IN PRE SCHOOL CHILDREN WITH DIFFERENT ANIMAL PROTEIN INTAKE (Gesell test).



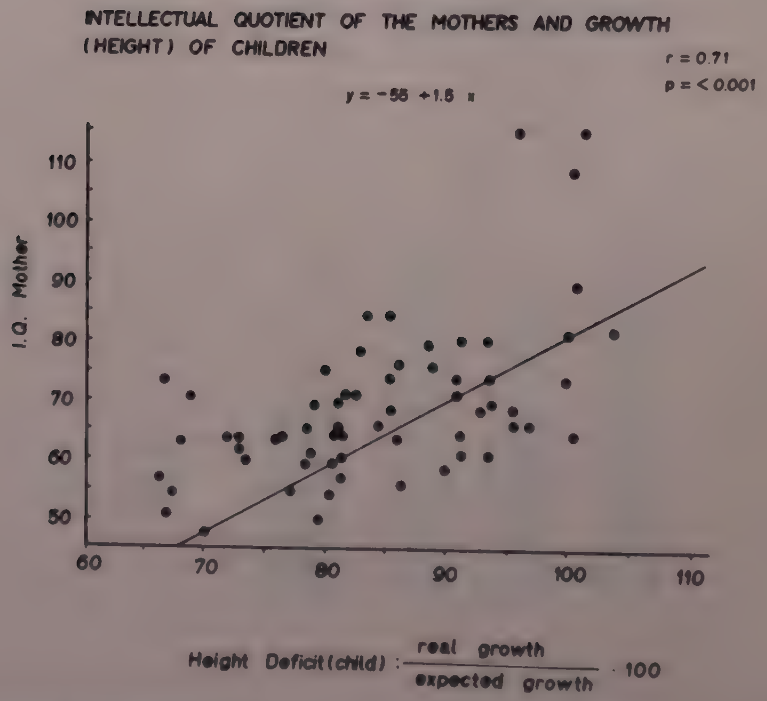
Frequency of mental deficiency in preschool children in a marginal population group in relation to the amount of animal proteins ingested

FIGURE 3



Relationship between deficit in growth of the skull and general growth rate of children in a marginal population of Santiago

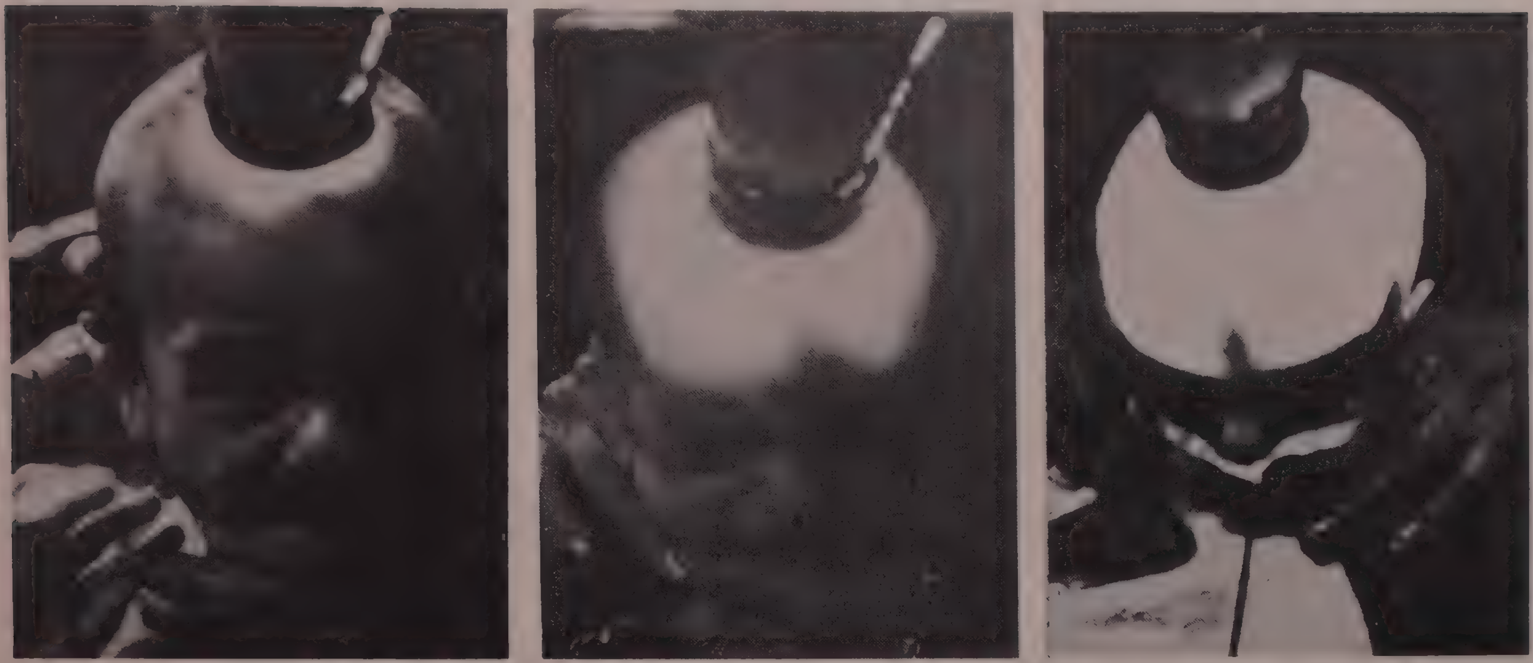
FIGURE 4



Relationship between maternal IQ and related growth of the child in a marginal population group of Santiago

FIGURE 5

TRANSILLUMINATION OF THE SKULLS OF A NORMAL AND OF AN UNDERNOURISHED INFANT



A B C

Cranial transillumination:

A : Normal infant
B and C : Marasmic infants with different degree of transillumination

TABLE 1

INTELLIGENCE QUOTIENT OF MOTHERS IN A MARGINAL POPULATION GROUP AS COMPARED WITH MIDDLE-CLASS MOTHERS

IQ	Marginal population group, %	Middle class, %
Normal (over 91)	6	96
Subnormal (80-89)	17	4
Deficient (under 79)	77	0

ring of light at the point where the apparatus is in contact with the skull, resulting from the transillumination of the small amount of cerebrospinal fluid which is normally present between the skull and the brain. On the other hand, in the undernourished child transillumination is intensely positive and the whole skull is lighted up(Figure 5). This is assumed to be due to a decrease in the volume of the brain, creating a space which fills up with cerebrospinal fluid. The decrease in volume is so great that it can be said that the brain almost floats within this fluid.

Conclusion

Apart from the burden of malnutrition in a developing country, there is the problem of the low intellectual capacity of a high percentage of the population. This restricts the possibility of their ever becoming really integrated into a modern, highly technical society, for only a small percentage of the population can reach satisfactory technical and scientific levels. It suffices to mention, for example, that the height of Latin Americans ranges between 1.59 and 1.64 metres in the various countries, but those who are admitted to the universities exceed the average height by 3 centimetres, as in the case of Chile. They represent a small group whose environment has been sufficiently favourable for them to develop their full genetic potentialities, both mental and physical.

It can be assumed, then, that underdevelopment leads to malnutrition, that malnutrition decreases mental ability and that the decrease in mental ability leads once more to underdevelopment. As was said at the beginning, this not only affects those suffering from malnutrition but also compromises society as a whole. It is frequently asked why the Latin-American countries cannot make social and economic advances such as those achieved by European countries devastated by two wars. The answer lies in the facts analyzed above; we cannot perform miracles like those of France, Germany and other European countries. It is true these were devastated, but the human factor with its intellectual capacity, education, culture and existing background remained untouched. The serious aspect of the problem is that such a handicap exists in the twentieth century, when technology and science are advancing with such giant strides that every day it becomes more difficult for us to catch up, thus creating a gulf between the advanced and the underdeveloped countries.

The task is a difficult but not impossible one, since it is safe to say that man already has the technical and scientific knowledge necessary to solve the problem, provided he remains aware of its existence and importance and is prepared to tackle it.

References

1. Aulley, W., and E. Mertz. 1966. Effect of food restriction and age on rat brain phospholipid levels. Fed. Proc. 25:674.

2. Barja, I., M. De la Fuente, D. Ballester, F. Monckeberg, and G. Donoso. 1965. Peso y talla de pre-escolares chilenos de tres niveles de vida. Rev. Chilena de Pediatría 36: 525.

3. Cravioto, J., E. De Licardie, and C. Birch. 1966. Nutrition, growth and neurointegrative development: an experimental and ecologic study. Pediatrics 38: 319.

4. Dobbing, J., and E. Widowson. 1965. The effect of undernutrition and subsequent rehabilitation of rat brain as measured by its composition. Brain 88: 357.

5. Donoso, G., and F. Monckeberg. 1965. Desnutrición infantil. Consideraciones generales y epidemiología. Rev. Chilena de Pediatría 36: 301.

6. Dublin, L., A. Latka, and M. Spiegelman. 1947. The money value of a man.

7. Errazuriz, O., S. Oxman, and F. Monckeberg. 1969. Estado nutritivo y evolución de la laringitis post sarampionosa. Congreso Nacional de Pediatría. Viña

del Mar, Chile.

8. Flaxner, L. Loss of memory in mice as related to regional inhibition of protein synthesis. Texas Report of Biology and Medicine.

9. Food and Agriculture Organization of the United Nations. 1964. Production year book. FAO, Rome, Italy.

10. Gallegos, A., T. Barros, and F. Monckeberg. 1969. Encuesta nutritiva de preescolares del Departamento de Putaendo. Congreso Nacional de Pediatría, Viña del Mar, Chile.

11. Guggenheim, K., and E. Buechler. 1948. Nutrition and resistance to infection. The effect of quantitative and qualitative protein deficiency on the bacterial properties and phagocytic activity of peritoneal fluids of rats. J. Immunol. 58: 133.

12. Monckeberg, F. 1967. Adaptation to caloric and protein restriction in infants. Colloquium on caloric and protein deficiencies. Cambridge, England.

13. Monckeberg, F., M. Perretta, F. Beas, S. Rubio, C. Aguiló, A. Maccioni, and J. Rosellot. 1965. Algunos aspectos en el tratamiento de la deshidratación aguda del lactante 20: 1.

14. Monckeberg, F. 1967. Effect of early marasmic malnutrition on subsequent physical and psychological development. Malnutrition, Learning and Behaviour. M.I.T. Press, Massachusetts, U.S.A. p. 269.

15. Monckeberg, F., G. Donoso, S. Valiente, and A. Arteaga. 1967. Análisis y comentario de la encuesta nutritiva y de las condiciones de vida de la población infantil de la provincia de Curicó. Rev. Chilena de Pediatría 38: 522.

16. Monckeberg, F. 1968. Efecto de la nutrición y medio ambiente sobre el desarrollo psicomotor en el niño. Cuadernos Médico Sociales, Colegio Médico de Chile 9: 5.

17. Monckeberg, F. 1969. Malnutrition and Mental Behaviour. Nutr. Rev. 27: 191.

18. Nutrition Survey Chile. 1961. Report by the Interdepartmental Committee on Nutrition for National Defence.

19. Sako, W.S. 1942. Resistance to infection as affected by variations in the proportions of protein, fat and carbohydrate. J. Pediatrics 20: 475.

20. Scrimshaw, N. S., L.E. Taylor, and J. Gordon. 1959. Interactions of nutrition and infection. Amer. J. Med. Science 237: 367.

21. Stoch, M., and P. Smythe. 1967. The effect of undernutrition during infancy and subsequent brain growth and intellectual development. Sud. Afr. Med. J.

22. United Nations. 1963. Demographic Year Book.

23. Yankauer, A., and N. Ordway. 1964. Las enfermedades diarreicas y los programas de cuidados de salud de America Latina. Bol. Of. Sanit. Panam. 56:466.

24. World Health Organization. 1967. Situación sanitaria de las Americas. Crónicas de la OMS 21: 167. Organización Mundial de la Salud.

NUTRITION AND INFECTION[*]

By Leonardo J. Mata, Chief, Division of Microbiology, Institute of Nutrition of Central America and Panama (INCAP), Guatemala City, Guatemala.

A longitudinal follow-up study of children from birth to six years was initiated in 1963 in a highland Mayan-Indian village of 1300 inhabitants, where old traditions are maintained and conditions leading to malnutrition and infectious diseases prevail (2). Anthropometric, clinical, dietary and microbiological data were obtained at frequent intervals from cohort children from birth to at least the sixth birthday. Some of the important observations are summarized.

The enteric agents isolated during pregnancy in the mothers of cohort children are given in Table I.

TABLE I. ENTERIC AGENTS ISOLATED IN MOTHERS DURING PREGNANCY (1964-1965)

Number of mothers	Agent	Percentage positive
24	*Entamoeba histolytica*	54
	Entamoeba coli	92
	Dientamoeba fragilis	8
	Giardia lamblia	8
	Ascaris lumbricoides	83
	Trichuris trichiura	58
	One or more parasites	100
116	Shigellae	9
	Salmonellae	5
32	Enteroviruses	25
	Adenoviruses	3

It would appear that almost all the mothers were harbouring one or more pathogenic infective agents in the alimentary tract and would have suffered from clinical disease at some time or other during pregnancy. Also, the food intake during pregnancy was not adequate in a great proportion of the mothers. The percentage adequacy of nutrient intake of two village mothers, one from the higher socioeconomic group and the other from the lower income group, in the second trimester of pregnancy, and of the same age, height, and family size are shown in Table II.

Deficient diet and frequent infection during pregnancy undoubtedly lead to low birth weights. The height, weight and head circumference of 323 infants from a series of 355 consecutive births occurring in the village from 1964 to 1970 are presented in Table III. The data are compared with data for infants from the high socioeconomic group of Guatemala, who are similar to infants from industrialized societies.

Undoubtedly both factors, the poor nutritional state and the frequent episodes of infection in the pregnant women, determine the growth deficit observed at birth. In a series of 70 randomly-selected infants of the same village, elevated levels of cord IgM were detected in 43% (4). Since significant amounts

[*] Paper submitted as background material for the Second *ad hoc* Working Group Meeting on Feeding the Preschool Child

of this immunoglobulin do not cross the placental barrier, and specimens with admixture with maternal blood had been discarded, the findings indicate the production of antibodies by the foetus. A significant proportion of the intrauterine antigenic stimulation was probably mediated by maternal-foetal infection, suggesting the establishment of nutrition-infection interaction in utero. The significance of frequent intrauterine infections in population groups of low socioeconomic condition must be assessed in relation to the growth and development, both physical and mental, of the children.

Birth weight was found to be related to the survival of children. Data on the mortality of infants according to birth weights are presented in Table IV. Village children with birth weights below 2100 grammes had a greater neonatal and postneonatal mortality than children born with greater weights.

TABLE II. PERCENTAGE ADEQUACY OF NUTRIENT INTAKE OF TWO PREGNANT WOMEN (1967)

Nutrient	Adequacy, %	
	Woman A	Woman B
Total calories	136	80
Total protein*	115	74
Calcium	124	76
Iron**	203	119
Vitamin A	103	21
Riboflavin	92	42
Vitamin C	120	60

* Most protein is of vegetable origin, mainly corn Figures are not corrected for biological value.

** Most iron is of vegetable and pulse origin.

TABLE III. WEIGHT, HEIGHT AND HEAD CIRCUMFERENCE OF VILLAGE AND CITY NEWBORNS

Parameter	323 Village newborns	300 City newborns*
Weight, g	2540±409**	3261±417
Height, cm	45.6±2.3	49.9±1.1
Head circumference, cm	32.1±1.5	34.2±0.95

* Hurtado (1)

** Means ± 1 standard deviation.

TABLE IV. DEATHS OF INFANTS ACCORDING TO BIRTH WEIGHT

Weight, grammes	Number of children	Deaths*		
		neonatal	post-neonatal	total
<2100	33	6(18)	10(30)	16(48)
2100-2499	95	3(3)	5(5)	8(8)
2500-2899	137	2(1)	8(6)	10(7)
2900+	53	0	0	0

* Rounded percentage in parenthesis.

During the early neonatal period, some infants were found to suffer from frequent infections and it was possible to isolate pathogenic agents from stool samples. For example, during the neonatal period, shigella was isolated in 3.7% and one-fourth of all infants excreted enteroviruses in the first week of life. Infections increased with age, tended to be of more prolonged nature and were more frequently associated with clinical manifestations (3). Figure 1 depicts the history of a cohort child in the first three years of life. Weekly visits to the home and frequent examinations permitted a detailed clinical study. It was evident that despite a deficient birth weight, many children, like this one, grew well in the first few months of life. This was greatly due to adequate nutrition through successful breast-feeding, protection from infection effected by maternal antibodies received through the placenta and milk, and other mechanisms. As weaning began and passive immunity decayed, infections occurred frequently, often accompanied by symptoms. Multiple and associated illnesses were also common. This particular child had, in the first three years of life, as measured in the stools: 84 weeks with enteroviruses; 4 with adenoviruses; 8 with shigellae; 1 with enteropathogenic Escherichia coli; 18 with Entamoeba histolytica; 12 with Giardia; and 52 with Ascaris.

Several illnesses were followed by faltering of weight or weight loss. A relationship between weight gain and infectious disease was observed, in the sense that the children who grew better experienced fewer illnesses, while children with defective growth were ill more frequently (4). Dietary intakes were severely deficient during the weaning process, particularly in the second year of life. Relative improvement was observed after the third year, but the children, in general, were already stunted with no apparent catch-up later on.

Although further studies in the field are necessary to understand clearly the nutrition-infection interactions in preindustrial societies, it can be safely asserted that poor diets and frequent infection affect the human host beginning with intrauterine life. The diets of mother and child in low socioeconomic populations are deficient, but the magnitude of infection is, by itself, an important determinant of undernutrition and deficient growth of foetus and child.

References

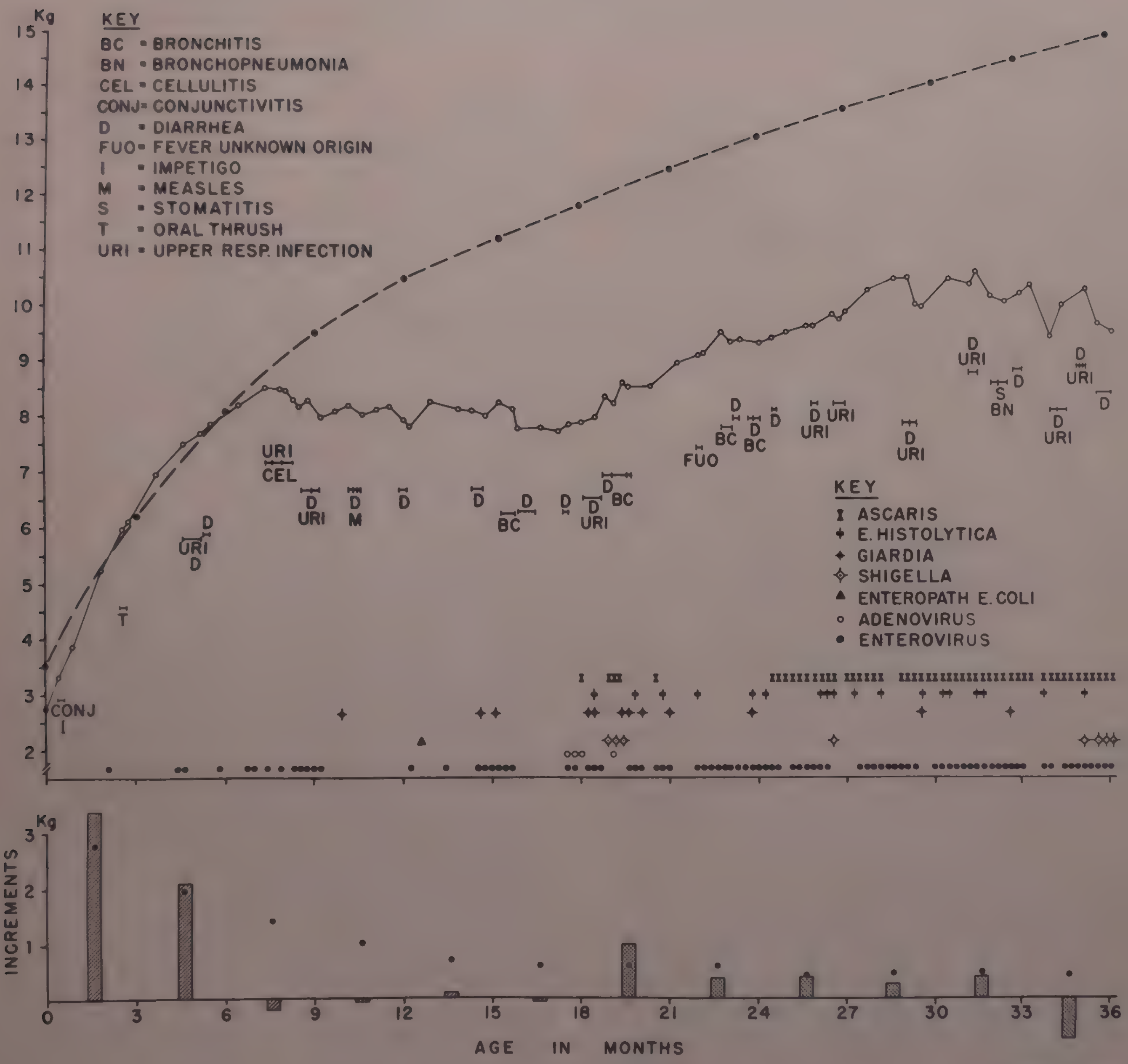
1. Hurtado, J. J. 1962. Estudio del crecimiento en lactantes Guatemaltecos bien nutridos. Guatemala Pediatrica, 2(7): 78-94.

2. Mata, L. J., J. J. Urrutia, and B. Garcia. 1967. Effect of infection and diet on child growth: experience in a Guatemalan village. Ciba Foundation Study Group, Nutrition and Infection, pp. 112-126. Churchill, London, England.

3. Mata, L. J., and J. J. Urrutia. 1970. Intestinal colonization of breast-fed children in a rural area of low socio-economic level. Ann. N. Y. Acac. Sci. In press.

4. Mata, L. J., J. J. Urrutia, and A. Lechtig. 1970. Infection and nutrition of children of a low socio-economic rural community. Am. J. Clin. Nutr. In press.

FIGURE 1



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KEY :

Top: The solid line represents weight of child; the broken line is the median of the standard. The length of each horizontal line indicates duration of infectious disease. Each mark shows a week positive for the particular infectious agent.

Bottom: Observed weight increments (vertical bars) and expected median increments of the standard.

Singapore

WORKSHOP ON MALNUTRITION

The Southeast Asia Development Advisory Group (SEADAG) convened a Workshop on Malnutrition, 21 - 24 September 1970 in Singapore, in which twenty-seven nutritionists from thirteen countries and agencies participated.

The meeting was oriented toward intensive discussion to bring forth new ideas on approaches to programmes on malnutrition in children, from birth to two and one-half years. The three discussion topics of the workshop were:

1. Identification of key problem areas
2. Selection of specific programme and research activities with priorities
3. Mechanisms for implementation and evaluation with resource identification

Each of the topics received a review of the position in each country of the Southeast Asia region as background data for a basis of discussion and development of recommendations.

Five key areas were established as major problems in reference to malnutrition in preschool children in the region. These were as follows:

1. Lack of national food and nutrition policy
2. Inadequate nutrition education
3. High rate of population growth
4. Economic problems
5. Inadequate health delivery systems

Deliberations were restricted to the first two key areas because these were the only areas in which the professional nutritionist could expect to assist in programme plans for resolving malnutrition in children in this age group.

The failure of countries in the region to have a national food and nutrition policy within the context of their national economic plans was considered the basic reason that malnutrition has not been evaluated in terms of economic benefits; that effective coordination and integration of food and nutrition programmes have not been accomplished; and that goals and priorities have not been established in food and nutrition programmes. The meeting confirmed the essential need for establishing a national food and nutrition board by decree of an executive agency of the government to serve in an technical advisory capacity to all agencies involved in food and nutrition programmes. It was considered that a national food and nutrition board should identify problems and recommend action programmes and research toward a satisfactory solution of the problems.

Mother and child health programmes should provide the framework for integrating nutrition activities to preschool children and nutrition education for mothers. Through operational research, the best programme approaches should be explored in different types of communities, including the use of the mothercraft centre, the child nutrition centre, the applied nutrition programme and, when feasible, the broad education and community development framework. For the school-age child, nutrition education should be an integrated component of the regular education curriculum.

The following research areas were considered the most significant in priority attention for the preschool child:development of nourishing foods, efficacy of food fortification, definition of nutritional needs from birth to two and one-half years of age, study of dietary habits of this age group, determination of growth and development of this age group, and significance of food toxins.

The maximum use of the existing infrastructure personnel in all countries was emphasized for nutrition promotion. It was considered desirable to establish more training facilities for nutritionists, especially for peripheral level programmes. High-level training should emphasize supervisory and directional capability for nutrition activities at lower levels.

The need for a regional centre to disseminate nutrition information to workers in all countries was recognized. Existing national institutions should be utilized for the collection of information and its dissemination to individuals concerned with a national food and nutrition policy.

MRM

Bogota, Colombia

CONFERENCE OF PAEDIATRICIANS AND REPRESENTATIVES OF THE INFANT FOOD INDUSTRY ON FEEDING OF INFANTS AND YOUNG CHILDREN IN LATIN AMERICA AND THE CARIBBEAN

A conference on feeding of infants and young children in Latin America and the Caribbean was held in Bogota, Colombia, 5 and 6 November 1970, under the sponsorship of the Pan American Health Organization/World Health Organization and UNICEF. The Food and Agriculture Organization attended as an observer. Twelve paediatricians and twelve representatives of the food industry participated. Two members of the PAG, Dr. Bo Vahlquist, Sweden, and Dr. O. Ballarin, Brazil, acted as Chairman and Vice-Chairman, respectively.

The main objectives of the conference were to emphasize the importance of prolonged breast feeding in developing countries, to consider tentative guidelines for the promotion of infant foods, to discuss development and distribution of lower-cost weaning foods, and to consider other possibilities of public health and industry joint action.

Discussions were held under the following headings:
- a) Nutrition problems in Latin America and the Caribbean
- b) Infant feeding in low income groups
- c) Purchasing power of Latin American consumers and distribution of family budget
- d) Effects of infant food marketing in developing countries.

One half-day was devoted to visits to hospitals, health centres, markets and low-income residential areas in Bogota.

After separating for a time into working groups, the conference in plenary session reached general agreement on some tentative guidelines for promotion of infant and weaning foods in developing countries. It is planned to promote further consultations on these matters among the industry, paediatricians and others interested in improving nutrition in Latin America and the Caribbean.

BV/LJT

Algiers, Algeria

MAGHREB SEMINAR ON NUTRITIONAL PROBLEMS OF THE PRESCHOOL - AGE CHILDREN

The Government of the Democratic and Popular Republic of Algeria, with the collaboration of FAO, WHO and UNICEF, organized a seminar on the nutritional problems of the preschool-age children in the Maghreb region, which took place in Algiers from 9 to 16 October 1970.

The five Maghrebin countries met to discuss their problems of preschool-age nutrition and to look for solutions adapted to the particular economic, social and ecologic conditions of this region.

Delegations from the five Maghrebin countries of Algeria, Libya, Mauritania, Morocco and Tunisia attended the seminar and more than one hundred participants from the public health, agricultural, social, economic and educational sectors participated in the working sessions.

In addition to representatives from FAO, WHO, UNICEF and the International Children's Centre, Professor Jean Tremolières, Head of the Human Nutrition Unit, Hôpital Bichat (Paris) and Professor G. Debre of the Faculty of Medicine of Nancy (France) participated in the seminar.

The seminar was opened by His Excellency the Minister of Public Health of Algeria. Prior to the formal inauguration of the seminar, a meeting of the five delegations took place from 9 to 12 October to study their common problems regarding the nutritional status of the preschool child and of pregnant and nursing women.

The report issued from this working session was submitted to the plenary seminar and was used as a guideline for seeking and defining short- and medium-term solutions to solve the serious nutritional problems existing in this region.

Communications were delivered on: nutrition and infection; nutrition and social development; nutrition education; the problems of training in nutrition; applied nutrition programmes; agricultural projections in Algeria; PCM prevention programmes; weaning foods tolerance and acceptability tests; the Algerian weaning food; technological and economic aspects of weaning foods; and commercial sales and social distribution of weaning foods.

A series of conclusions and recommendations were then drafted. They will be published, together with the working papers, in a special report to be issued by the Algerian National Institute of Public Health.

PL

Bangkok, Thailand

SEMINAR ON PROTEIN FOOD PROMOTION

This seminar, held from 22 November to 1 December 1970, was sponsored jointly by the Kasetsart University, the Department of Health and the USAID office in Thailand. The objective of the seminar was to stimulate the food industry of Thailand in the development, production and marketing of protein food products based on indigenous resources.

The participation was largely from the Government and institutions of Thailand. Invited representatives from Singapore, the Philippines and India were present. Representatives of USAID, USDA, the U. S. Department of Health, Education and Welfare and selected academic institutions were in attendance as principal speakers and panel members. The food industries of the U. S. A., Japan and Sweden were well represented and a number of food industries of Thailand were also present. FAO, UNICEF and UNIDO were also represented.

The discussion topics of the seminar included:

1) Protein and protein food sources in relation to nutrition problems
2) Agricultural development in relation to protein food and nutrition
3) Role of the Government and the commercial sector in protein food development and production
4) Promotion and marketing of protein products.

The official opening of the seminar was preceded by a field visit to Chiengmai in the north as an introductory feature to demonstrate the use of protein foods in village child nutrition centres. The conclusions and recommendations made at the end of the seminar can be summarized as follows:

1) Enhanced activities of the food processing industry of Thailand in the production of protein foods were encouraged. The Government of Thailand was asked to give assistance to the foods industry in this endeavour.
2) The Government of Thailand was asked to establish a national food and nutrition policy in which priority needs of food nutrient production would be emphasized, in order that foods could be developed into highly nutritious products.
3) The importance of protein nutrition for young children, particularly the preschool child, was emphasized. The production of a weaning food was stressed, as well as the development of programmes within the Government structure whereby these children would be reached.
4) The Government of Thailand was asked to consider providing incentives to food processing firms for the development and marketing of protein foods which would be an integral part of a scheme of national nutrition improvement.
5) A strong food industry association should be established in Thailand which could cooperate with Government agencies and thereby improve food processing techniques, promotion of foods for improved nutrition, and marketing channels for foods throughout the country.
6) Existing laws, regulations, and standards pertaining to the whole food industry should be reviewed and strengthened in order that the food processor and consumer will have maximum protection. The regulations and standards should be realistic.
7) Through continued research and development in food science, food technology, and nutrition, the limited human and physical resources of Thailand can be used to

maximum benefit. Training abroad in these professional fields should continue, and job opportunities for persons with training in these fields should be expanded.

GDK

IAEA:

IMPROVING PLANT PROTEIN BY NUCLEAR TECHNIQUES

A Symposium organized jointly by the International Atomic Energy Agency and the Food and Agriculture Organization was held in Vienna on 8 - 12 June, 1970. The following is the foreword to the Proceedings which were published by the IAEA in September 1970.

Sophisticated nuclear technology is most readily applied to sophisticated problems in advanced countries, but nuclear techniques can be used for less sophisticated and much more practical purposes in less developed countries. The aim of the Symposium, jointly organized by the IAEA and FAO and held in Vienna on 8 - 12 June 1970, was to review past experience and to propose new ways by which nuclear - and other advanced - techniques might be applied to the protein problem, in particular for the increased production of high-quality protein from plant sources. Since crop plants, especially cereal grains, are the basic food for most of the world's population in less developed countries, such crops are also the main source of protein. These plant sources, however, generally have low protein content and are deficient in certain essential amino acids, so that they are inadequate for nutritional needs. Increasing the quantity and nutritional quality of this protein is thus potentially the most feasible means of combating protein malnutrition.

Improvement of plant protein sources is clearly feasible by plant breeding since gene mutations can markedly raise the levels of the nutritionally limiting amino acids in seed protein, as was shown first with maize. Here nuclear techniques have particular application, not only in producing radiation-induced variation, but also in permitting, by radioisotopic methods, true mass screening of plant individuals for protein and amino-acid content. In addition, isotopic methods make it easier to estimate nutritional values.

Production of high-quality protein by the plant depends both on external factors such as fertilization and environment and on internal factors such as its own biochemistry and physiology. Valuable knowledge of these factors has been acquired by the application of isotopic techniques, but more is needed to achieve maximum production of plant protein through improved agronomic practices.

The Symposium dealt with all these aspects of the subject. But to place the specialized scientific contributions within a broader perspective it began and ended with general papers on the protein problem and on international co-operation. The present book contains all the papers and a record of the discussions.

IAEA. 1970. Improving plant protein by nuclear techniques. International Atomic Energy Agency, Vienna, Austria.

P. L. Pellett and S. Shadarevian:

FOOD COMPOSITION TABLES FOR USE IN THE MIDDLE EAST

A new, expanded second edition of food composition tables.

The first edition of these food tables was published in 1963. The present edition has incorporated data on many new food items, for iodine, sodium and potassium for several local foods and amino acid composition of local protein foods. Also, a separate section contains recipes and nutritional data for many composite diets commonly consumed in this area.

While most of the data in the first edition of the tables were extracted from the literature, the new information in the present publication has been obtained by actual chemical analysis. The introductory chapter sets out the essential details of the analytical methods adopted. The data are presented in four separate sections: major nutrients; iodine, sodium and potassium; amino acids; and recipes and their nutrient composition. There is a useful set of appendices, including one giving local names for the foodstuffs.

Pellett, P. L. and S. Shadarevian, 1970. Food composition tables for use in the Middle East. American University of Beirut, Beirut, Lebanon.

Max Milner:

PROCESSING AND FOOD ACCEPTANCE ASPECTS OF PLANT BREEDING

The following is a summary of a paper prepared for the 17th PAG Meeting. It emphasizes the importance of including consumer acceptability and processing characteristics in plant breeding considerations.

At its meeting in Geneva, Switzerland, September 1969, the PAG issued a statement regarding plant improvement by genetic means. This statement stressed mainly the potential impact of new varieties with improved protein nutritive quality. The paper emphasizes the considerable drawbacks which may inhibit increased production, such as problems in acceptance by producers, consumers and processors. For example, high lysine corn varieties do not normally yield as well as the parent strains. They are more susceptible to certain plant diseases, and the soft and mealy characteristics of the endosperm apparently adversely affect milling properties and acceptance by consumers. The paper brings these residual problems into focus by means of selected examples of efforts to develop new varieties of maize, wheat, rice, pigeon peas, and tomatoes.

Milner, Max. 1970. Processing and food acceptance aspects of plant breeding. PAG, United Nations, New York, U.S.A. 6 pp. Mimeographed. PAG Document 1.16/3.

Alan D. Berg:

NUTRITION AS A NATIONAL PRIORITY : LESSONS FROM THE INDIA EXPERIMENT

The following summarizes a paper prepared for the 17th Meeting of the PAG. It describes efforts in India to gain recognition of nutrition considerations in national planning. The paper was prepared by Alan D. Berg, now at the Brookings Institution, Washington, D. C., U. S. A. and formerly with USAID, India .

The concept of nutrition and nutrition activity is often not considered an integral part of national development. Traditionally, it is viewed as a humanitarian task or welfare problem and relegated to the background in national planning. Unfortunately, policy makers and administrators fail to see or be convinced of the staggering childhood mortality and morbidity arising from malnutrition and fail to connect the low physical and mental efficiency of the people with chronic nutritional deficiencies. This attitude may constitute a major block to national development.

This paper traces the background of several events which occurred in India during the last few years and explains how some of these developments helped to reinforce one another , culminating in the Government and the political leaders accepting nutrition as an important arm of national development and pronouncing a national nutritional policy.

For well over half a century, Indian scientists and nutrition workers have been making excellent contributions to our knowledge of nutritional problems as they affect the Indian people. Unfortunately, however, much of this remained unutilized due to lack of communication between the scientific community and Government authorities. It took the Bihar famine of 1966-67 and its aftermath to dramatize the implications of malnutrition in national development. It created a slowly mounting awareness of the magnitude and seriousness of nutritional problems among politicians, planners, administrators, leaders of society, and business managers and brought them together with the nutrition scientists and food technologists to draw up a blueprint for nutrition activity. The Bihar famine coupled with the observations of nutrition scientists both in India and abroad that severe malnutrition in early life affects not only body growth and physical efficiency but also may be responsible for poor intellectual performance made a deep impression on the people at the helm. This led to the adoption of a children's charter by the political party in power and inclusion of a special section on nutritional problems and programmes in the fourth five-year plan.

Successful introduction of high-yielding seed varieties, combined with rapidly increasing inputs of fertilizer and other tools of modern agriculture, have led to a rapid increase in production. India's first venture into fortification of cereal foods came with the introduction in January 1968 of the so-called "Modern Bread", fortified with lysine, vitamins and minerals. The Government has approved large-scale fortification of atta; the programme was initially launched in the metropolitan areas. Intensive research coupled with feeding trials are also being undertaken to test the value of fortifying common salt with iron and calcium. Research is in progress to evaluate the suitability of tea as a vehicle for fortification. Expansion and streamlining of the existing school lunch programme and launching of a massive preschool child feeding programme are other elements in the National Nutrition Plan.

In this spurt of nutrition activity, the role of private enterprise, the food and pharmaceutical industries, was to establish the Protein Foods Association of India, primarily to channel their collective efforts to solve the protein problem. The Association has organized a series of regional food habit surveys to learn what the people eat and how, so that the manufacturing potential could be directed towards preparation of nutritious protein-rich foods which are cheap and acceptable to the people. Several foods are being developed at present and a study of new marketing mechanisms is under way. In collaboration with the Government, an extensive educational campaign has been mounted using all types of mass media.

This catalog of new developments does not mean that India has solved all its nutritional problems. It only means that the problem has been recognized and the people and the Government are committed to doing something positive. There is no doubt that this will spread, resulting in cumulative significant health gains.

This planning and implementation of nationwide nutritional efforts had generated significant and welcome byproducts such as greater flexibility of administrative procedures and increased dependence on sophisticated application of new technology, both scientific and managerial, once looked upon with suspicion. It has also led to a coming together of business managers, Government officials, scientists, and technologists to explore and experiment beyond conventional boundaries, to a recognition of the importance of social science in solving problems of nutrition, and has made adjustments in the operation of foreign aid.

Berg, Alan D. 1970. Nutrition as a national priority: lessons from the India experiment. PAG, United Nations, New York, N. Y., U. S. A. 27 pp. Mimeographed. PAG Document 1. 17/1.

WHO:

NUTRITIONAL STATUS OF POPULATIONS: A MANUAL ON ANTHROPOMETRIC APPRAISAL OF TRENDS

A manual prepared at a meeting of investigators on anthropometric data as criteria for trends of nutritional status of population groups. The meeting was convened by WHO at Geneva between 11 and 17 December 1968.

The value of body measurements in the assessment of nutritional status is now recognized and anthropometric techniques have been the subject matter of a few publications in this field. This manual was prepared to enable the WHO to evolve a system for following up the trends in nutritional status of world populations, with special emphasis on the developing countries. This WHO project for an ongoing surveillance of nutritional status, undertaken with the help of a number of cooperating institutions in different countries, is significant. There are very little precise data on body size and measurements and a complete lack of information on changes in child growth patterns and adult physique, in the same population groups, resulting from rapid changes in food production and consumption. Growth and physical characteristics are influenced by changes in other environmental factors and therefore require careful evaluation of results.

The procedures outlined in the manual were tested in a pilot project in Yugoslavia and the results were available for the preparation of the document. The manual includes simple and practical methods which are at the same time sensitive enough to detect alterations in the dietary intake. It describes the sampling procedure, definitions and techniques of measurement(with illustrations), organization and training of survey teams, and record forms and data processing. The meeting recognized the need for periodic review of the manual in the light of experience gained in the operation of the project. Apart from its value in the assessment of changing trends in nutritional status of the population groups, the results of the project will be of value in estimating nutritional requirements in other epidemiological diseases such as cardiovascular diseases, diabetes, etc. and in designing equipment and tools for human use from the point of view of occupational health and ergonomics.

Though prepared for use in WHO projects, the manual will be of help to other groups engaged in studies in this area.

World Health Organization. 1970. WHO Nutrition Document 70.129. Unpublished.

S. R. Simon, F. Cesario, I. L. Kinne and D. M. Yates:

A SYSTEMS APPROACH TO THE WORLD PROTEIN PROBLEM

The following summarizes a report which explains in popular terms the implications of using a systems approach to the world protein problem. Figures 1 and 2 suggest factors that must be taken into consideration in such approaches. Since data are not yet sufficient to permit a systematic application of this approach, the first step will be to gather more of the relevant data and determine the interrelationships between the various factors affecting such systems. When sufficient data are available for some countries, the system may be applied on a test basis.

Considerable interest has been shown in late years in the application of a systems approach to the edible protein field. The Battelle Memorial Institute, Columbus, Ohio, U.S.A., prepared a study on the present potential of the use of the system for presentation at the 17th Meeting of the PAG in May 1970. The report points out that the term "systems analysis" means different things to different people. To some it means simply a systematic way of looking at things; to others the term is synonymous with mathematical abstractions, sometimes incomprehensible except to other mathematicians, of everyday phenomena. A systems approach can actually mean both of these things. Systems analysis uses many different types of analytical tools; these may be highly complex or quite simple. Normally, the approach involves developing a model which is an abstract representation of the situation and the environment which influences it. The model may thus be a series of complex mathematical formulae or simple diagrams, or some other relatively simple formulation, depending on the types of questions being investigated, the objectives of the analysis, and the complexity of the situation. The systems approach must also take into account the interplay between factors.

An important advantage of a systems approach is that in the perfect system the same conclusion would be reached by different analysts, since the technique attempts to replace subjectivity with objectivity. However, since complete objectivity is impossible, human judgement will always play a role. The virtue of the approach is that judgements are spelled out and a systematic and efficient use is made of them. At best, any model will always be a simplification of real life.

It must be realized that protein deficiency is not the basic problem but a facet or symptom of other problems which may be cultural, political, economic, physical or, in most cases, multidimensional, involving all the various factors to some degree. It is also necessary to recognize that protein is only one component of the diet; vitamins, minerals, calories, etc., are also present. Two preliminary steps are necessary: 1) determination of the current diet and 2) definition of an adequate diet. One of the basic objectives of a systems approach to the food problem is to determine the interrelationship between nutrition and other aspects of the social and economic environment. If this were done effectively, policymakers and other decisionmakers could use the tool in formulating policies which may make an effective contribution to development. In Figure 1, a simplified description of a basic food production and marketing system is given. The system begins with the supply of agricultural production inputs and ends by identifying the food deficiencies.

Figure 2 shows basically the same system as Figure 1, but with several things added. The additions mean that there is no longer a beginning or an end to the system. It is a closed-loop system which better depicts the real world and its highly interrelated parts. However, it is still not complete; many factors that affect the dietary gap are not shown. They are represented in the study by detailed flow diagrams of 1) agricultural production, 2) food marketing and 3) consumption sectors of the system. Each are subsystems of the system illustrated in Figure 2.

Before a systems approach to the protein problem can be used, the following technical steps must be taken:

1) Formulating the nature of the most important relationships
2) Gathering data of the required quantity and quality
3) Testing hypotheses, i.e., the relationship between factors
4) Developing a computer programme
5) Verification of the model by testing it and comparing the results with actual results.

One problem is that a model cannot include every detail of the real world. Therefore, it is necessary to decide what factors are important enough to be included in the model. Then, the important variables and the interrelationship between them must be identified.

The report points out that analysts tend to rely on linear systems of equations. This is simply because such a relationship is more easily estimated. However, since the world is filled with nonlinear relationships, it will often be necessary to calculate with nonlinear techniques. One must also accept so-called lagged variables, which means that one factor may influence another in time. These would exist in a food and nutrition system and must be included.

The lack of data is still the main obstacle to the use of a systems approach in this field; until sufficient data are available, no reliable model can be developed.

For this reason the report recommends that, for the present, efforts should be made to obtain sufficient data in a single country to construct a simplified yet quite adequate simulation model. This would be developed in stages, gradually incorporating data and interrelationships and feedbacks and thus further refining the model. Voids in the data would be filled by expert judgement. When a sufficiently advanced model has been developed, it should be tested against real life situations. Not until a satisfactory correlation is found between the model's prediction and real-world performance should the model be

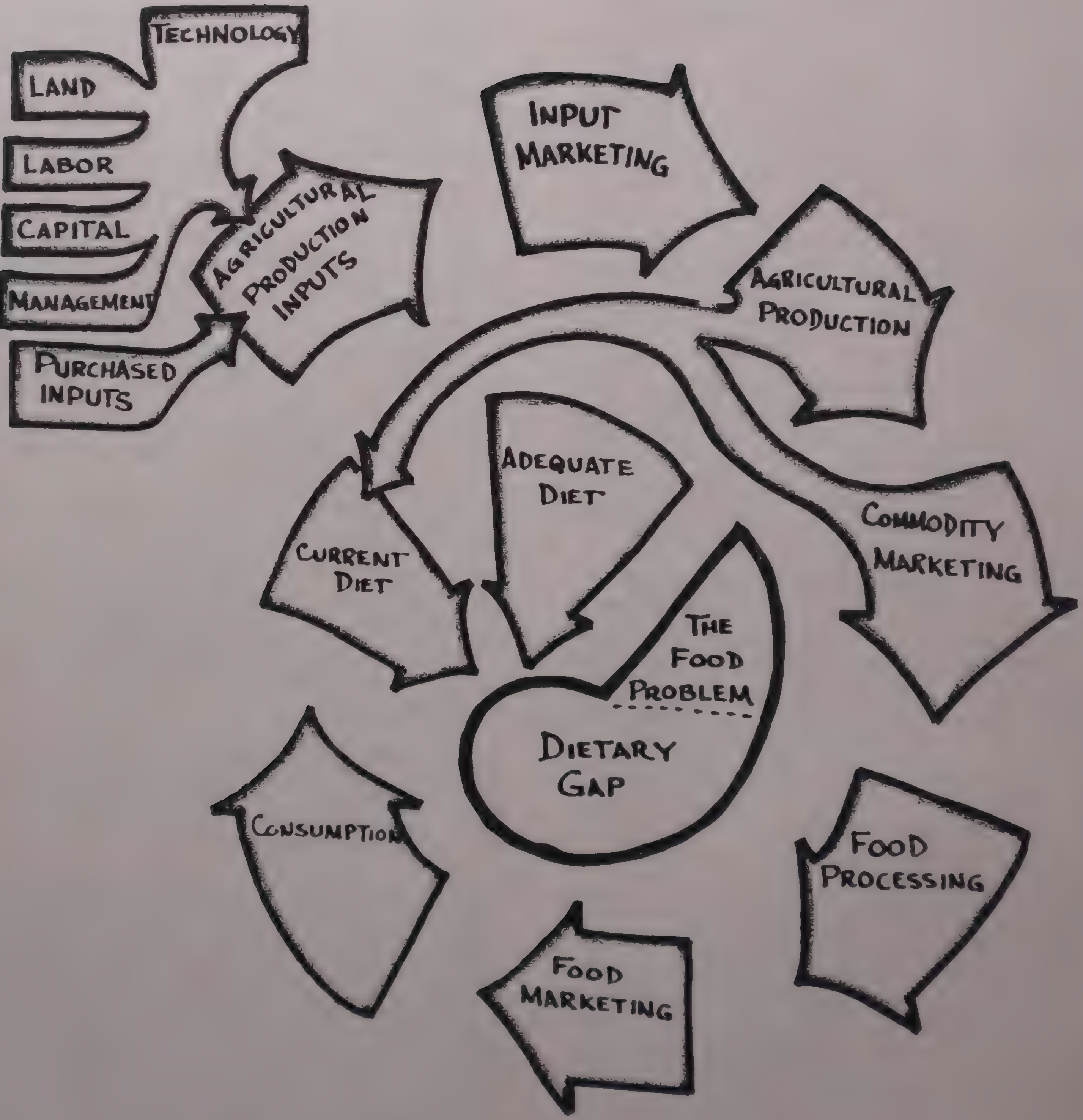
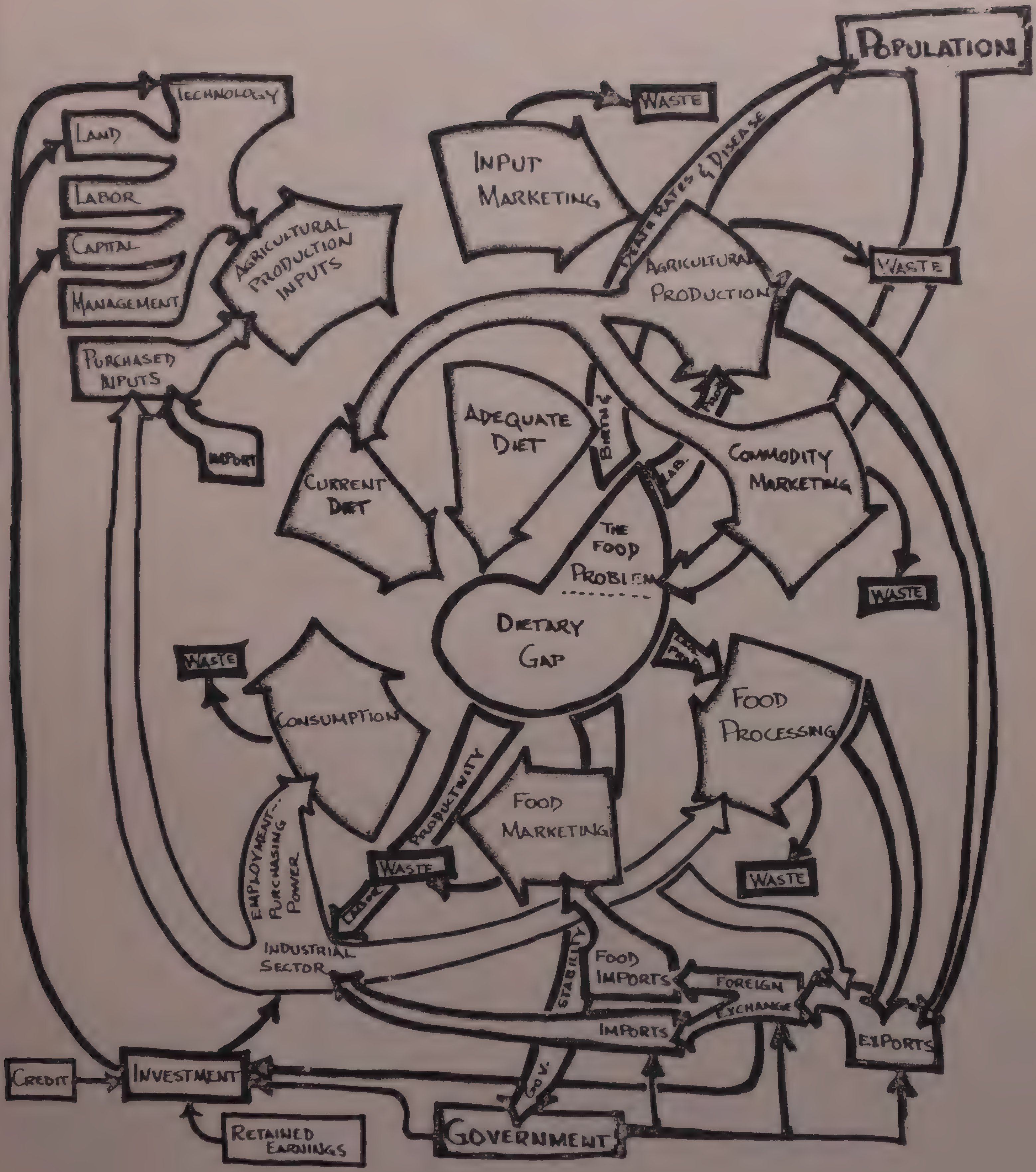

TECHNOLOGY
LAND
LABOR
CAPITAL
MANAGEMENT
PURCHASED INPUTS
AGRICULTURAL PRODUCTION INPUTS
INPUT MARKETING
AGRICULTURAL PRODUCTION
COMMODITY MARKETING
ADEQUATE DIET
CURRENT DIET
THE FOOD PROBLEM
DIETARY GAP
CONSUMPTION
FOOD PROCESSING
FOOD MARKETING

FIGURE 1. BASIC FOOD PRODUCTION/MARKETING SYSTEM


POPULATION
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LAND
LABOR
CAPITAL
MANAGEMENT
PURCHASED INPUTS
IMPORT
AGRICULTURAL PRODUCTION INPUTS
WASTE
INPUT MARKETING
DEATH RATES & DISEASE
AGRICULTURAL PRODUCTION
WASTE
FOOD
ADEQUATE DIET
BIRTHS
CURRENT DIET
LAB.
COMMODITY MARKETING
WASTE
THE FOOD PROBLEM
DIETARY GAP
WASTE
CONSUMPTION
FOOD PROCESSING
PRODUCTIVITY
FOOD MARKETING
EMPLOYMENT-PURCHASING POWER
WASTE
WASTE
INDUSTRIAL SECTOR
STABILITY
FOOD IMPORTS
FOREIGN EXCHANGE
IMPORTS
EXPORTS
GOV.
CREDIT
INVESTMENT
RETAINED EARNINGS
GOVERNMENT

FIGURE 2. THE "TOTAL" FOOD SYSTEM

used as a guide to policy-making.

Only when sufficient experience has been obtained with such a model should consideration be given to constructing a multinational or regional model.

The report includes a review of the following studies:

A linear programming approach to agro-economic planning: the nutritional criterion. 1967. TEMPO, The General Electric Company, Santa Barbara, Calif., U.S.A.

United States Agency for International Development. Comprehensive nutrition plan. 30 pp. Unpublished.

Cantor, S. M., G. E. Shaffer, and A. N. Meiss. Comparison of alternate international strategies: a study of the possible role of fish protein concentrate in a developing country. Sidney M. Cantor Associates, Inc., Haverford, Pa., U.S.A. Undated.

Simon, S. R., F. Cesario, I. L. Kinne and D. M. Yates. 1970. A systems approach to the world protein problem. PAG, United Nations, New York, N.Y., U.S.A. PAG Document 1.13/2. Mimeographed.

FAO:

AMINO-ACID CONTENT OF FOODS AND BIOLOGICAL DATA ON PROTEINS

Data on amino acid content and biological value are commonly used today to assess the nutritive quality of the protein in foods, to evaluate the protein supplies in various countries and to serve as the basis for developing nutritionally sound food policies. For these reasons, the FAO has assembled all the available data in this area.

During the last decade numerous studies have been carried out to determine the amino acid content of foods and the biological value of proteins. At the same time, techniques have been improved considerably and methods standardized.

The data, presented in the form of numerous tables, are divided into two parts. In the first, the level of amino acids in foods and chemical scores are presented. The second part gives data relating to biological value, digestibility, net protein utilization and protein efficiency ratio. Each table provides all information in English, Spanish and French.

There is no doubt about the great value of this publication. However, the tables show that several gaps exist in the present knowledge of the amino acid content of foods and the biological data on proteins. The FAO urges that reprints of publications or copies of unpublished reports containing data of this nature be sent to:

Food Policy and Food Science Service
Nutrition Division
Food and Agriculture Organization of the
United Nations
00100 Rome, Italy.

FAO. 1970. Amino-acid content of foods and biological data on proteins. Nutritional Studies No. 24. Food and Agriculture Organization of the United Nations, Rome, Italy. 285 pp.

F. J. Levinson and D. L. Call:

NUTRITION INTERVENTION IN LOW INCOME COUNTRIES: ITS ECONOMIC ROLE AND ALTERNATIVE STRATEGIES

This is a summary of a paper submitted as background information for the 17th PAG Meeting in May 1970. A model for national nutrition planning in low income countries is presented for purposes of facilitating discussion of this often neglected planning process. An effort is made to clarify the role of nutrition in the growth process and then to present a framework in which alternate strategies or nutrition intervention programmes might be compared and evaluated.

Part I, titled Nutrition and Development, presents the threefold role of nutrition in the development process:

1. It may increase productivity in the agricultural and industrial sectors when labour itself is the limiting factor. Preschool age malnutrition and its effect on mental development may have a more pronounced effect than deficiencies among adults. In the case of the latter the importance of nutrition appears inversely proportional to the complexity of the production process. Where nutrition does affect adult productivity the latter is most likely a function of caloric adequacy as opposed to poorly balanced nutrient intake.

2. Nutrition may also increase the motivation of reproductive age parents to accept birth control measures by decreasing infant mortality and increasing the likelihood that existing sons will survive. If one accepts this hypothesis, one could measure the contribution of nutrition to population control by the resulting reduction in preschool child mortality. Furthermore, the addition of a nutrition dimension to health centres could well augment their effectiveness and drawing power for family planning purposes.

3. Improved nutrition will also improve health directly, a basic subgoal of development. In so doing it will bring about a decrease in morbidity which in turn could significantly reduce a country's real and potential medical costs and its infant and child mortality rates. In terms of overall economic growth, the consumption-oriented investment suggested by the third role is generally considered less useful than employment-generating investment in low income countries. For vulnerable groups, however, with higher requirements for nutrients more difficult to procure, increased income accruing from the development process is unlikely to be sufficient. In addition to widening protective foods/cereals price ratios, income distribution is frequently skewed against families of these vulnerable groups. Thus, independent nutrition concern and action are warranted even though national incomes may be rising.

Part II, the Model for Nutrition Planning, lays out diagrammatically and in narrative a sequence of primary factors which taken together could form the basis for determining the content of a national nutrition policy. These factors lie along three subpaths leading toward accomplishment of nutrition objectives. The first, and the one dealt with at greatest length in the discussion, is the conscious, and usually government-directed, nutrition intervention programme.

The second subpath is income. While the analysis suggests that 1) moderate increases in income alone are inadequate to meet the nutritional needs of the target groups, and that 2) these increases in relative income are not an automatic function of economic growth in its early stages, there is still little question that income is a crucial factor in nutritional well-being. In fact, it is undoubtedly the single most important factor. It is the inability of income to accomplish the objective rapidly and single-handedly which suggests the need for additional action.

The third path involves the removal of other restricting health factors, primarily infection and parasitism, arising from such problems as inadequate environmental sanitation, disease (e.g. malaria and measles), and respiratory infection, all of which seriously restrict the utilization of those nutrients which are ingested.

Determination of optimum nutrition intervention programmes (the first subpath) in a particular country should be the responsibility of a central nutrition planning body. Using the model sequence, alternate intervention programmes (e.g. genetic plant breeding, agricultural production diversification, food fortification, child feeding, processed nutritious foods, or nutrition education) would be systematically compared by a set of criteria, the weighting of which would necessarily be done on a country by country basis. These criteria are grouped into the following categories: 1) relative nutritional effectiveness, 2) costs and distribution, 3) consumer acceptability, and 4) a series of general requisites.

In the case of the first category, the major problem lies not in the laboratory but in subsequent field testing, particularly in isolating the effect of the nutrition intervention variable from those of numerous other influences on the parameters being studied.

The determination of per capita cost of a programme involves consideration of the number of target group beneficiaries, rather than of the total population. Cost compilations should include not only the cost per unit of goods or services but also the "opportunity cost" of its components or raw materials. They should also include transportation and handling and storage costs, plus those of education, promotion and administration. Finally, cost subsidization must be considered. The transportation cost assumes the existence of a distribution network capable of reaching a large proportion of the target group. Unless such a mechanism exists the distribution costs may be prohibitive.

Consumer acceptability in low income countries is divided into three categories: aesthetics, culture, and degree of familiarity with the form or institution.

The "general requisites" constitute a series of factors which, though fitting into none of the above, are frequently major determinants of programme success. The first of these is a minimum foreign exchange allocation, a second is speed of implementation, and a third is political acceptance, which includes such elements as visibility and vested interests.

Part III is concerned with a final means of comparing alternate strategies, namely through their economic and social multipliers, or benefits to other priority development sectors. Consideration of these relationships with agriculture, population control, education, and income will not only be creating important interdisciplinary linkages, but in terms of overall development will maximize resource allocation.

Levinson, F.J., and D.L. Call. 1970. Nutrition intervention in low income countries: its economic role and alternative strategies. PAG, United Nations, New York 10017, U.S.A. Mimeographed, 25 pp. PAG Document 1.13/1.

FJL

Ovido A. Valenciano:

POSSIBILITIES FOR INCREASING PRODUCTION AND CONSUMPTION OF PROTEIN FOODS

This booklet, which appears in Spanish, was published in connection with the first symposium on proteins in Buenos Aires, Argentina, 18 to 21 May, 1970. It reviews the development in world population and in world food production and consumption, the latter based mainly on FAO's statistics, and including several references to the situation in the Argentine.

The prospect of the use of protein-rich foods is discussed together with the improvement in protein quality which may be obtained by the rational combination of various vegetable protein sources, etc. The booklet also considers the aflatoxin problem and the use of various oilseeds. It gives accounts for Argentina, Brazil, Chile, Colombia and Peru with regard to efforts to introduce protein-rich foods. Finally, the booklet discusses the possibilities seen in the use of nontraditional protein sources, such as fish protein concentrate, leaf protein concentrate, plankton and single cell protein.

Valenciano, Ovidio A. 1970. Possibilidades de incrementar la produccion y consumo de alimentos proteicos. Provincia de Buenos Aires, Ministerio de Bienestar Social, Dirección de Contralor Sanitario, Buenos Aires, Argentina. 63 pp.

MJ

Albert H. Moseman:

BUILDING AGRICULTURAL RESEARCH SYSTEMS IN THE DEVELOPING NATIONS

A review of some components of agricultural research programmes and their interrelationships in a national system.

The book reviews the development of agricultural research in the U.S.A., its close relationship to the land grant colleges, and the relationship between research by these, and those sponsored by the U.S. Department of Agriculture and State Research Stations. It also describes the extensive use of an extension service and reviews in some detail estimated returns on investment in some research efforts in the U.S.A. The book then describes some cases of research organization in developing countries which have resulted in succesful adaptation.

Moseman, Albert H. 1970. Building agricultural research systems in the developing nations. The Agricultural Development Council, Inc., New York, N.Y., U.S.A. 137 pp.

Research Corporation:

A PRACTICAL GUIDE TO COMBATING MALNUTRITION IN THE PRESCHOOL CHILD

A report of a Working Conference on Nutritional Rehabilitation or Mothercraft Centres, National Institute of Nutrition, Bogota, Colombia, March 1969.

While welfare-type supplementary feeding programmes are urgently needed at times for humanitarian and practical reasons these programmes do not correct the causes of malnutrition. Effective nutrition education must be conducted if a lasting improvement in the health of the world's children is ever to be realized. Accordingly, many countries have established centres which serve to educate mothers of malnourished children and, at the same time, to rehabilitate the children. The cost of this kind of solution is generally one-seventh to one-tenth of the average expense for hospital care, which fails to provide education for the mother and consequently does not help to prevent malnutrition in the younger sibling.

The book is intended as a guide for organizations and individuals engaged in work in mothercraft centres. The authors are twenty-three scientists, physicians, nutritionists and activists, who have planned, established, operated and evaluated nutritional rehabilitation or mothercraft centres in most of the nations where such centres now exist. The text contains a wide range of information ranging from organizational charts to useful hints for selection of staff and determination of the age of a child without a birth certificate.

Research Corporation. 1970. A practical guide to combating malnutrition in the preschool child. Nutritional rehabilitation through maternal education. Appleton-Century-Crofts, . Educational Division, Meredith Corporation, New York, N.Y., U.S.A. 74 pp.

FIRST UNDP GLOBAL PROJECT TO STIMULATE WORLD PRODUCTION OF HIGH-LYSINE MAIZE

The United Nations Development Programme (UNDP) is providing $1,653,200 for the International Maize and Wheat Improvement Centre (CIMMYT) in Mexico to intensify research on raising the quality and quantity of lysine protein in maize along with high yield, and to train agronomists to carry out national programmes of nutritive maize production. FAO is supplying technical advice. This project, "Global 1", became operative on 16 March 1970 and will last three years.

CIMMYT, an outgrowth of years of cooperative effort between the Mexican Government and the Rockefeller and Ford Foundations, is an autonomous international research and training institute. Its work on developing high-yield strains of wheat and maize is well known.

Maize is normally deficient in the essential amino acids, particularly lysine and tryptophan, and its protein is of relatively low nutritional value. In 1963, however, a mutant gene was discovered, which resulted in a maize with a modified amino acid composition which was properly balanced for human needs. In 1966, CIMMYT began to work with Opaque-2 and Floury-2, mutants which have opened up new prospects for the improvement of nutritional quality. Since then sufficient progress has been made to warrant optimism about the possibility of combining high yield and nutritive value in grain types adaptable to a wide range of ecological conditions. However, several problems have still to be solved before commercial varieties of high-lysine maize can be obtained.

Project activities, besides demonstration and training, comprise:

Genetic research, to study the influence of gene modifications on kernel appearance in flint- and dent-type maize; to continue the search for varieties which combine desirable amino acid balance with acceptable appearance, and to attempt to induce new mutants artificially; to study the effect of environment on kernel appearance in high-lysine maize; to identify and incorporate into breeding material marker genes which would allow rapid identification of plants containing high-lysine mutant genes; and to study the influence of high-lysine genes on yield and total grain protein when incorporated into maize populations of different genetic backgrounds.

Chemical research, to develop techniques for nondestructive analysis of the very large numbers of single-kernel samples needed in the breeding and production programmes.

Breeding. The ultimate expectation of world-wide use of high-lysine varieties means that they will first have to be introduced by hybridization into many genetic backgrounds and then selected for use in a wide range of ecological and farming conditions. The basic crossbreeding programme will be carried out at CIMMYT before any material is released to the principal collaborators for further local breeding and selection.

NEW U.S. DEPARTMENT OF AGRICULTURE TECHNOLOGY FOR PROCESSING EDIBLE LEGUMES

The deleterious flavour which develops in virtually all legumes with processing is caused mainly by indigenous lipoxidase enzyme activity. As in the case of the preparation of soybean milk, off-flavours appear within moments after wetting. The USDA method uses water at normal temperatures but with acid added to bring the pH to a range of 2 to 3.5, a condition which prevents lipoxidase activity until the enzyme is destroyed by subsequent cooking. The advantages claimed are that leaching and product losses due to heat insolubilization are minimized. Acid-soaked beans can be ground with water under conditions which break up cell walls without fear of off-flavour development.

Clean dehulled beans are soaked in acidified water at about 50% water content. They are then ground with additional water into a fine slurry on a Reitz mill. The combined soaking and grinding breaks down the cell walls and thus measurably increases the availability of nutrients. After cooking for fifteen minutes, the slurry is neutralized and then passed over a drum drier. The resultant dry bean powder is claimed to be completely bland and free of characteristic "beany" flavours.

The following species of legumes were processed in this manner: phaseolus vulgaris (common navy or kidney bean); soybean; phaseolus aureus (mung bean); vicia faba (broadbean); cicer arietinum (chickpea); vigna sinensis (cowpea); and cajanus cajan (pigeon pea).

All the above species, except pigeon pea, yield the typical lipoxidase off-flavour effects under ordinary processing. This lipoxidase-induced off-flavour was absent when the acid-soak process was used. Soybean powders produced in this way were entirely bland and quite soluble. Digestibility values of these processed bean powders showed considerable increase over the same beans prepared by ordinary cooking. With methionine as a sole supplement, PER values of the bean powders were equal to that of casein. The flatulence factor was reduced in this process by about half or two-thirds; studies on means of further reducing this factor are in progress. Commercial-scale processing costs have yet to be worked out. Equipment used in the pilot plant is entirely analogous to full-scale equipment.

DEVELOPMENT AND MARKETING OF DURYEA, A NEW PROTEIN - RICH WEANING FOOD

A portion of an article entitled "The Role of Private Enterprise in Marketing Foods to Lower Income Consumers in Developing Countries" by H. C. Frost, President and General Manager, CPC Food Technology Institute, a unit of CPC International Inc. It was published in the Foreign Economic Development Report 7 "The Marketing Challenge", U. S. Department of Agriculture, December 1970.

The need for nutritious supplementary foods for infants and young children in Colombia led to the decision by Maizena, S. A. (a member of CPC Latin America) to introduce a weaning food into the market. Duryea was put on the market in Cali, Colombia, in July, 1969. This was done in spite of the presence in the market of Incaparina, Colombiharina and Pochito as processed weaning foods. Market analysis had shown a relatively small penetration of these products and the possibility that another product, if properly tailored to consumer preferences, might achieve good penetration.

Market research showed that the most widely consumed foods for this age group were bottle-feeding formulas (teteros) and thin gruels (coladas). A distinct preference for corn-based products was evident. With this background data, it became possible to write a concept statement fully defining the type of product needed. A decision was made to use high-lysine corn as a major ingredient in the product. Numerous formulations were developed; some were discarded as not meeting the cost target and others were consumer-tested until a high enough rating was achieved. A product formulation was finally developed which met consumer acceptance requirements, provided at least minimum nutritional needs, and came within the cost specification.

The main ingredients of the formula are precooked high-lysine corn flour, soy flour and powdered milk with added vitamins and minerals. One hundred grammes of Duryea provides 345 calories and contains the following:

Protein, g	28
Carbohydrate, g	57
Fat, g	2
Vitamin A, IU	2000
Thiamine, mg	0.5
Riboflavin, mg	0.6
Vitamin C, mg	40.0
Niacin, mg	6.0
Calcium, mg	450.0
Iron, mg	7.0
Phosphorus, mg	350.0
Potassium, mg	900.0

The choice of the formulation presented some important marketing challenges. Though low cost is a must if penetration of the low economic groups is to be achieved, there is much evidence to show that adherence to this principle alone may lead to failure. Even the poorest people will not consume lower-cost food repetitively unless they continue to like it. A primary requirement is to assure acceptance by consumers; thereafter, nutritional adequacy at the lowest cost must be satisfied.

Packaging was another factor which was carefully considered. Apart from its function of protecting the product during its normal storage life, the package conveys a message and creates an image in the mind of the consumer. A cheap package can easily create the image of a second-class product and may on this account be rejected by low income families who need the protein-rich products for their children. Also, the package graphics should tell a story, an important factor in point-of-purchase choice by the consumer. The preparation instructions on the package must be in both words and pictures, since many in the lower income groups cannot read and must have instructions conveyed by pictures. As with formulation, the marketing choice of an acceptable package must compare the desired result with cost, with the final compromise having an important bearing on success.

Still another important marketing decision was the size of the package. The tendency often is to market larger sizes to take advantage of the somewhat lower cost per unit weight of product. Since the amount of money available to spend at any time may limit the ability of the purchaser to buy a product, the unit price must be carefully selected.

These challenges were resolved for Duryea by choosing the formulation that was repeatedly picked as being best liked by consumers. The packaging chosen was a sealed polyethylene bag containing the product inside a paperboard carton. The unit size chosen was 250 grammes, to be priced at 2.80 pesos (about US 15.5 cents). This would provide 10 servings of the gruel (colada) each containing 6.8 grammes of good quality protein for 1.7 cents and 17 servings of the bottle-feeding formula (tetero) each containing 4.0 grammes of protein for 1.0 cent.

An important requirement of a protein-rich food which is to be marketed is that it be nutritious for its intended consumers. Apart from satisfying local government authorities regarding its nutritional adequacy, confirmation of nutritional quality within the country has the merit of building confidence among nutritionists, paediatricians, public health workers and others who may be anxious to help consumers understand the benefits which a product can bring them. The nutritional adequacy of Duryea was demonstrated through animal and clinical tests undertaken at the Universidad del Valle in Cali.

The advertising campaign to acquaint potential consumers with Duryea was heavily oriented to radio. The widespread use of radios even in the poorest homes and the value of communication by audio means among those who cannot read were major factors in this decision. An effort was made to gain distribution in all retail outlets in the Cali area and some 2000 outlets were eventually selling Duryea.

Point-of-purchase and in-store demonstrations where customers tasted the product and had an immediate opportunity to purchase it was helpful in introducing Duryea. The support of key individuals in the government, public health workers and paediatricians were important factors in bringing Duryea favourably to the attention of potential consumers.

In the intervening months since Duryea gained distribution, the results have been satisfying. The product is being consumed repetitively by children in all income groups. It is particularly gratifying to see its penetration in the lowest income groups. Its sale will be expanded to other cities in Colombia as raw materials and production facilities become available.

In spite of Duryea's apparent initial success, relatively little is known about the many challenges imposed in marketing products successfully to low income groups in developing countries. The knowledge needed to introduce foods to such groups with a reasonable likelihood of success can be gained only through experience.

A LOW - COST PROTEIN SOFT DRINK FROM SOYBEANS

Soybean milk, widely consumed by the Chinese, has always been prepared on a modest scale by housewives for home consumption; until recently, no one had undertaken to produce it on a commercial basis for the large consumer market.

In 1968, a company in Singapore (Yeo Hiap Seng Ltd.) began packaging its soymilk in "Tetra Pak". This package, widely used for milk, comes in a tetrahedron shape. It is made from kraft paper lined with polyethylene-coated aluminum foil and is one of the few which can be used in a process where the product is sterilized before being sealed in a sterilized container.

The soybean milk is heated to 142°C, held for four seconds, quickly cooled to room temperature and packed in previously sterilized containers. The method of sterilization and packaging under sterile conditions enables the product to be kept without refrigeration for about eight months. The product is much improved in both appearance and taste over that resulting from the normal sterilization at 115° for fifteen minutes.

A similar product, called "Vitabean", has also been introduced. This is soybean milk which has been enriched with various vitamins, including vitamins A, B_1, B_2, B_6, C, D_3, nicotinamide, and pantothenic acid. A soft drink of this nature, retailing at about US 6¢ for a 284-cc bottle, provides a low-cost protein source. The manufacturing cost is in the range of 2¢ per bottle.

RAPID IDENTIFICATION OF GRAIN MUTANTS UNUSUALLY RICH IN PROTEIN

At a recent symposium organized jointly by FAO and IAEA and held in Vienna, Austria (see page 26), it was reported that a rapid method for determining the quality of protein in mutant seeds has been developed at the Lawrence Radiation Laboratories, University of California, Berkeley, Calif., U. S. A.

The lack of a quick, nondestructive method of determining the quality of protein in mutant seeds has retarded the efforts of agricultural scientists to systematically improve the protein content of grains. Scientists at the Lawrence Radiation Laboratories have shown that essential amino acids in seeds can be measured by X-ray photoelectron spectroscopy. Tiny seed portions were bombarded with X-rays in a β-ray spectrometer. The X-rays stimulate atoms in the sample to emit electrons and it is possible to measure the energies of the ejected electrons, revealing a characteristic energy pattern for each of a number of amino acids in the protein molecules. If the sample shows promising amino acid content, the remainder of the seed can be planted and will grow. Thus mutants are selected rapidly and scientifically and not by trial and error.

INFORMATION AND ADVISORY CENTRE ON PROTEIN FOODS

The first "Symposium on Protein Foods", held in Buenos Aires on 18 - 21 May 1970, recommended the creation in the School of Biochemistry and Pharmacy of the University of Buenos Aires of an "Information and Advisory Centre on Protein Foods".

The Dean of the School of Biochemistry and Pharmacy on August 31, 1970 signed a resolution as follows:

1) To create an "Information and Advisory Centre on Protein Foods" in the Department of Nutrition and Food Science of this school under the Direction of Professor Dr. Juan Claudio Sanahuja.

2) This Centre will have the following functions:

a) To popularize all the scientific information concerning the scientific knowledge, production and technology of protein foods and their application in human nutrition.

b) To be in contact with the international organizations concerned with this subject, FAO, WHO, UNICEF and especially with the Protein Advisory Group (PAG) of the United Nations, in order to obtain and exchange all available information on protein foods and their applications.

c) To give information and advice on protein foods when requested by governmental institutions, nongovernmental societies, industrial firms and all others interested in this problem.

The centre is functioning now in the building of the School of Biochemistry and Pharmacy. Further information may be obtained from Dr. Juan Claudio Sanahuja, Advisory Centre on Proteins, School of Biochemistry and Pharmacy, Junin 954, Buenos Aires, Argentina.

NUTRITION MASS COMMUNICATIONS PROJECT IN INDIA

The Protein Foods Association of India launched a Mass Media Nutrition Education Campaign in the State of Maharashtra and Delhi City on 12 September 1970.

Since a majority of the people do not have a knowledge of nutrition or the need to balance diets, and mass communications offer scope for tangible results, the project proposed to utilize the available mass media to spread the nutrition story. Advertisements in newspapers and journals, both in local languages and in English; exhibition of films; broadcasts of radio spots; and erection of billboards were some of the major activities planned.

The protein problem would be highlighted by projecting the serious effects of protein malnutrition on the child. Simple solutions would be indicated in the form of balancing diets with everyday foods. The campaign has no commercial overtones. The whole campaign revolves around the education of children and mothers. Apart from the fact that these segments of the population are the most vulnerable to protein deficiency, they offer the greatest motivational appeal.

In a message on the occasion, the Prime Minister of India, Mrs. Indira Gandhi, stated "Low incomes force malnutrition on a large number of our people. In India, even the better off groups suffer from diseases because of unscientific food habits. With greater knowledge and care, every family in the country, whatever its level of income, could derive more nourishment from what it spends on foods. Better food is the basis of a better life. . . . "

The campaign which was launched is a pilot study for one year to be run in the State of Maharashtra and Delhi City. The project includes evaluation research based on a benchmark study prior to the launching of the campaign and a postcampaign survey. The extension of the campaign at a later stage will depend upon the results of this research.

NEW SOYBEAN AND PEA MUTANTS

A mutant soybean plant which is expected to require less sunlight, water and fertilizer than the normal variety has been discovered. More of the mutant's protein seems to be found in its seeds, which are the source of oil and protein for use as food.

A new soybean mutant uses light energy more efficiently; it should be possible to grow such plants closer together. The amount of water required per acre does not depend on the number of plants, so less water would be used per plant. There is preliminary evidence that mutant plants have a greater proportion of their protein in their seeds. Since the total amount of protein is the same as in normal plants, a greater percentage of the nutrients that feed each plant goes into seed protein. Consequently, the mutant may require less fertilizer to make to same amount of seed protein.

Scientists have recently found a pea mutant that may also have a decreased amount of chlorophyll and a greater rate of photosynthesis. Similar mutants in other plants may be found by looking for poorly-coloured plants that seem to grow normally.

This information was reported by Dr. R. W. Keck at the International Conference on the Photosynthetic Unit, Gatlinburg, Tenn., U. S. A.

JAPANESE SCIENTISTS ISOLATE CONCENTRATED PROTEIN FROM RICE

Japanese scientists have successfully isolated a highly concentrated protein from rice endosperm, the cells that store food for the life support system of the seed embryo.

Japanese researchers have found that isolated protein bodies from rice endosperm contain 60 percent protein. They have described the remaining constituents as lipid, carbohydrate, phytic acid, RNA, thiamine, and niacin.

In describing electron micrographs of the rice protein bodies, the Japanese were the first to report an unusual characteristic in the protein subcellular structure. The micrographs revealed thick and thin concentric layers of electron-dense material similar in appearance to the annual rings of a tree. The significance of this structural pattern is not yet known.

The Japanese groundwork points to the desirability of identifying proteins within the protein bodies of rice endosperm and of characterizing their enzymes. This work, which requires sophisticated immunochemical techniques, would be the next step toward practical application of rice protein to food enrichment processes.

This work was sponsored by USDA's Agricultural Research Service under a Public Law 480 grant. The information was given in a U.S. Department of Agriculture release, 1 May 1970.

RECENT PUBLICATIONS

The Association for Childhood Education International. 1969. Nutrition and intellectual growth in children. Washington, D. C., U. S. A. 63 pp. $1.25.

CFNI. 1970. Interim food composition table for use in English-speaking Caribbean. The Caribbean Food and Nutrition Institute, Kingston, Jamaica. 19 pp.

Goldblatt, L. A. (Ed.). 1969. Aflatoxin. Academic Press, New York, N. Y., U. S. A. $21.50.

Harvey, D. 1970. Tables of the amino acids in foods and feedingstuffs. Technical Communication No. 19, 2nd edition. Commonwealth Bureau of Animal Nutrition, Farnham Royal,. Bucks, England. 40 shillings.

McCance, R. A. and E. M. Widdowson. 1968. Calorie deficiencies and protein deficiencies. Little, Brown, Boston, Mass., U. S. A. 386 pp. $16.50.

Venkataram, G. S. 1969. The cultivation of algae. Indian Council of Agricultural Research, New Delhi, India.

White House Conference on Food, Nutrition and Health. 1970. Final report. U. S. Government Printing Office, Washington, D. C., U. S. A. $3.00.

PAG STATEMENTS, GUIDELINES, AND DOCUMENTS AVAILABLE

PAG Statements

No.	Title	Date
2	PAG Recommendation on aflatoxin	1969
3	PAG Statement on the nature and magnitude of the protein problem	1969
4	PAG Statement on single cell protein	1970
5	PAG Recommendation on marketing	1969
6	PAG Statement on milk substitutes	1970
7	PAG Recommendation on prevention of food losses and protein calorie malnutrition	1969
8	PAG Statement on plant improvement by genetic means	1969
9	PAG Recommendation on amino acid fortification of foods	1969
10	PAG Statement on a systems approach to the formulation and evaluation of nutrition intervention programmes	1970
11	PAG Statement on leaf protein concentrate	1970
12	PAG Statement on research and development areas	1970

PAG Guidelines

1	Solvents for use in defatting oleaginous food materials (under revision)	1960
2	PAG Guideline for preparing food-quality groundnut flour	1970
3	A revised biological assay for the detection of aflatoxin (being withdrawn)	1964
4	PAG Guideline for preparation of edible cottonseed protein concentrate	1970
5	PAG Guideline for edible, heat-processed soy grits and flour	1969
6	PAG Guideline for pre-clinical testing of novel sources of protein	1970
7	PAG Guideline for human testing of supplementary food mixtures	1970
8	PAG Guideline on protein-rich mixtures for use as weaning foods	1971
9	PAG Guideline on fish protein concentrate	1971

PAG Statements and Guidelines may be used and quoted freely. Copies may be obtained without charge from the FAO/WHO/UNICEF Protein Advisory Group, United Nations, N. Y. 10017, U. S. A.

MEETINGS

November 25 to 29, 1970	IBP TECHNICAL GROUP ON LEAF PROTEIN Secretary: Dr. N. W. Pirie, Rothamsted Experimental Station, Harpenden, Herts., England.	COIMBATORE, INDIA
January 21 to 26, 1971	INTERNATIONAL UNION OF NUTRITIONAL SCIENCES Contact: Dr. C. G. King, Columbia University, New York, N. Y., U. S. A.	TUNIS, TUNISIA
March 22 to April 2, 1971	FAO/WHO EXPERT COMMITTEE ON ENERGY AND PROTEIN REQUIREMENTS.	ROME, ITALY
August 27 to September 3, 1971	THIRTEENTH INTERNATIONAL CONGRESS OF REFRIGERATION	WASHINGTON, D. C., U. S. A.
October 19 to 21, 1971	NUTRITIONAL, NATIONAL DEVELOPMENT AND PLANNING Co-Chairmen: Dr. Nevin S. Scrimshaw and Dr. David L. Call, Massachusetts Institute of Technology and Mr. Alan Berg, The Brookings Institution, Washington, D. C.	CAMBRIDGE, MASS., U. S. A.

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PAG

Bulletin

FAO/WHO/UNICEF Protein Advisory Group
United Nations, N.Y. 10017
U.S.A.

Food and Agriculture
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of the United Nations
Rome

World Health Organization
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United Nations Childrens Fund
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23/9/71
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International review of action to improve world protein nutrition

THE PAG BULLETIN

PURPOSE

The PAG Bulletin is published by the FAO/WHO/UNICEF Protein Advisory Group. Its purpose is to give information on the world protein problem to those individuals, academic institutions and industrial organizations who are interested in helping solve the protein problem and to promote the exchange of information in this field.

MAILING LIST

The PAG Bulletin is sent without charge to persons, organizations and companies with an active interest in proteins. The present list comprises 2,500 names, about one-third in the U.S.A. and the rest distributed through the rest of the world. Requests to be added to the mailing list for the PAG Bulletin should be addressed to the Secretary, FAO/WHO/UNICEF Protein Advisory Group, United Nations, N.Y. 10017, U.S.A.

QUOTATION

Permission to quote items from the PAG Bulletin is not required except from authors of signed articles. The Secretariat of the PAG would appreciate being informed of quotations that are made from the PAG Bulletin.

SUGGESTIONS

The PAG Bulletin will be successful only if it reflects all aspects of the protein problem comprehensively and objectively. The Secretariat invites suggestions and ideas for broadening and deepening the scope of the PAG Bulletin.

SECRETARIAT

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NOTE BY THE SECRETARY

My appointment as Secretary of the Group, which follows the brief administration of Dr. G. D. Kapsiotis, is announced elsewhere in this Bulletin. I look forward to working closely and cooperatively with the Chairman and Members of the PAG and with my colleagues in the Sponsoring Agencies and the Secretariat. It will be the Secretariat's first objective to maintain a high level of efficiency in its work and to constantly seek ways to improve its services to all interests of the United Nations and indeed to groups and individuals everywhere concerned with the global problems of protein supply and protein malnutrition.

Perhaps the most significant recent development in the continuing United Nations interest in the protein question was the convening by the Secretary-General in May 1971 of a high-level Panel of Experts to assist in formulating strategy and action needed to cope with the protein crisis in developing countries. This Protein Panel issued a strategy statement (ECOSOC E/5018, 2 June 1971, reviewed briefly in this Bulletin) setting forth several important recommendations the effect of which will be to increase concern in protein matters at all levels in the United Nations. It suggests also a broadening of the scope and responsibilities of the PAG. The report and its recommendations are at this time before the United Nations Economic and Social Council, whose recommendations in this regard will be considered by the General Assembly during its regular fall session. These important developments will be followed with great interest by all concerned.

Max Milner

EIGHTEENTH MEETING OF PAG, ROME, FEBRUARY 1971

The 18th Meeting of PAG was held at the FAO Headquarters, Rome, Italy, 9-12 February, 1971, under the chairmanship of Prof. N. S. Scrimshaw. Dr. F. T. Sai, a member of the PAG, was not able to attend. Representatives from the sponsoring Agencies, FAO, WHO and UNICEF and from Unesco, a full participating member Agency, took part in the meeting. The following other United Nations Agencies were represented at the meeting:

- The United Nations Advisory Committee on the Application of Science and Technology to Development (ACAST)
- The International Atomic Energy Agency (IAEA)
- The United Nations Office, Geneva, the Division of Social Affairs
- The United Nations Development Programme (UNDP)
- The United Nations Industrial Development Organization (UNIDO)
- The World Food Programme (WFP)

Also attending the meeting were a few guests and an advisor. The total number of participants was forty-five.

Opening statements

The Chairman extended a cordial welcome to the members, representatives of Agencies and other participants and guests.

Mr. O. V. Wells, Deputy Director-General, FAO, emphasized his interest in PAG activities and how the Group's documents and other publications have helped the FAO and the other Sponsoring Agencies in their work. He suggested that the Group might review the World Protein Situation and revise its earlier statement on the subject. The PAG could discuss its function and responsibilities in the light of the new developments following the United Nations General Assembly discussion on the protein problem and make recommendations on this subject to the Sponsoring Agencies.

World protein situation

The nature and magnitude of the protein problem cannot be predicted from overall food availability data alone. The factors that have to be taken into account were reviewed and the future prospects for protein and calorie supplies were considered. The need to explore many approaches and for action on several fronts was stressed. The resulting statement of the PAG on the "Nature and magnitude of the protein problem" appears elsewhere in this Bulletin (page 15). (The statement was sent as part of a background paper for the meeting of the Secretary-General's Panel of Experts to be convened in May 1971. The other part of the background paper is considered under the next item).

United Nations considerations of edible proteins

The Chairman traced the developments during the last several months, culminating in the United Nations General Assembly resolution on the subject, which requested the Secretary-General to prepare, with the assistance of independent experts and in close consultation with the Agencies and organizations of the United Nations System, a concise report on possible elements of a broad statement of strategy. The PAG was informed of the steps being taken to convene, in the early part of May 1971, a meeting of a panel of independent experts to formulate a strategy statement. The Chairman of the PAG was to participate in the meeting, and Dr. Sai, a PAG member, was one of the panel members.

It was recommended that PAG include in the background document for use at the meeting of the Secretary-General's Panel of Experts in May 1971, the revised PAG Statement on the "Nature and magnitude of the world protein problem" and a commentary on the fourteen specific proposals listed in the ACAST report on "International action to avert the impending protein crisis". The Group reviewed developments on each of the fourteen specific proposals contained on pages 9-17 of the ACAST report. In addition to comments regarding these proposals in the form of changes in emphasis or priority based on progress made and knowledge gained since the report was prepared, the PAG suggested that the following five additional priorities be added to the original fourteen:

a) Information and educational campaigns.
b) Special attention to protein needs of vulnerable groups.
c) Control and prevention of infectious diseases including parasitosis.
d) Recognition of the important relationship between family size, population growth and the protein problem.
e) Recognition of the role of economic development and social modernization in solving the protein problem.

It was also recommended that the terms of reference of the PAG be reexamined by the Agencies and that PAG should serve as a technical advisory body on the protein problem to all the technical Agencies in the United Nations System.

Popular participation and community involvement in programmes designed to bridge the protein gap

The document prepared by the United Nations Social Development Division provided background. The discussions brought out the significance of group activities and communal cooperation for the success of any food improvement programme launched to bridge the protein gap. Aspects covered in the discussion, besides those described in the document, were the distribution problem, status concept of food, mother's role, positive and negative role of the medical profession, psychological factors, price control and programme integration into national development. The PAG prepared a tentative statement on this subject. The revised background document, which includes some of the points brought out during discussion, is published elsewhere in the Bulletin (page 26).

Activities of regional and national centres for research and training in nutrition, food science and food technology with special reference to protein. The need for strengthening of existing centres and creation of new ones.

The Group considered a report presented by Dr. Parpia with special reference to training and research programmes undertaken at the Central Food Technological Research Institute, Mysore, India.

In view of the great importance of research and development centres and education and training centres in developing countries, the Group recommended that a detailed examination take place at the next PAG meeting. As a preliminary to this, information should be collected regarding the types of institutions in different regions together with an appraisal of their successes and analyses of their difficulties. The important items of information that should be obtained from research and development centres are: the administrative pattern, including sponsorship and sources of capital and other funds; relations with government, industry, other research centres (e. g. in agricultural production) and with educational institutions; the programmes and objectives; pilot plant facilities; relationship with industries and United Nations Agencies; appraisal of success in terms of national impact and regional impact; and training programmes for local counterpart personnel.

From the education and training centres, similar data on the above points should be obtained, in addition to information on level and length of training facilities for training staff and links between programmes in nutrition, food science, food processing, home economics, agriculture, economics and marketing.

Information should also be obtained on the education and training programmes and research and development programmes in operation in the country or region. It was recommended that information on the above aspects be obtained from institutions in some African, Latin American and Far Eastern countries.

The need for nutritional guidelines for use in agriculture and food production

At present, many countries, particularly those in the developing areas of the world, do not give emphasis to nutritional aspects of production. The Ministries of Food, Agriculture and Planning frequently view the problem of food production as purely one of quantity. There is a great need to prepare a guideline on the nutritional principles that should govern all national efforts in food production and distribution.

The guideline should point out the connection of the protein problem with the general development; the need for and extent of diversification of food crops, particularly protein-rich legumes and other vegetables; the need for raising the protein concentration of the crop and upgrading the protein value through selective breeding for digestibility and balanced amino acid content; the role of animal protein production (meat and milk) in order to reach optimum protein supply; the importance of reduction in quantitative and qualitative pre- and post-harvest losses; the need to train agricultural extension personnel with respect to nutritional aspects of production and consumption; the importance of appropriate research facilities and the role which food and nutrition units in Ministries of Agriculture have to play in recommending nutritional considerations in agricultural planning and training and extension activities. Though many factors are involved in food production and these vary from country to country, the PAG considered that a guideline should be prepared which would be useful to the agencies and member countries in indicating the basis for agricultural policies which serve the nutritional needs of the populations. The PAG recommended that a working group might be considered for this purpose.

Nutritional guidelines for protein-rich foods

The Group approved the nutritional guideline for protein-rich mixtures for use as supplementary foods prepared at the previous meeting, after incorporating the several useful suggestions received from various experts.

The revised guideline is published elsewhere in the Bulletin (page 10).

Influence of processing on quality and biological value of protein foods

The paper "Processing damage to protein foods" prepared by Dr. A. E. Bender formed the background document. The Group noted that the document had admirably reviewed the effects of heat processing on protein quality but only touched upon other aspects of processing technology which if inadequate, will affect the protein value. Examples of such effects were provided and it was recommended that the Group prepare a brief but comprehensive statement which will include all the different aspects discussed. Being an area where advances are constantly taking place, the Group felt that more information of this type should be obtained especially in the field of quality control and analytical techniques. The subject matter, it was felt, should be kept alive for consideration at future meetings.

The background document prepared by Dr. Bender will appear in a forthcoming issue of the Bulletin.

Relationship of protein-calorie malnutrition in early childhood and its possible effects on mental development, learning and behaviour

The recent observations on the subject were reviewed with special reference to the discussions which took place at the Joint WHO/FAO Expert Committee Meeting held in Geneva in November 1970. The PAG statement on the subject urged recognition of the fact that children experiencing severe malnutrition in infancy show not only permanently reduced physical growth and development but also impaired learning and behaviour. The factors involved in the latter are both nutritional and social. Malnutrition beyond one year of age, including episodes of kwashiorkor, may also be associated with poor test performance during the school years and later life, but this is believed to be due mainly to the social factors associated with the malnutrition rather than effects of nutrient deficiencies *per se*. Programmes to ensure adequate nutrition for the preschool child can contribute to improved learning and behaviour through their combined nutritional and social effects. This is one of the several reasons why programmes to ensure adequate protein, calories and other essential nutrients for the preschool child should have such a high priority in nutritional planning and programmes for national development.

In the report of the Eighth FAO/WHO Joint Expert Group on Nutrition it was pointed out that recent research has provided some new insights into the relationship of foetal nutrition to mental and physical development during childhood. After 26 weeks of gestation, foetal growth in developing countries tends to slow down and results in an increase in the number of "small-for-date" babies. These babies have greatly increased perinatal morbidity and mortality rates and suffer a high incidence of sublethal damage with long-lasting effects. In general, children born of malnourished mothers are more seriously affected by subsequent postnatal malnutrition. This fall in growth of the foetus in the last trimester of pregnancy can be prevented by adequate feeding of the malnourished mother. An adequate diet during lactation is also necessary to assure optimum breast feeding of the young child. The PAG endorsed the statement on the subject contained in the report of the FAO/WHO Joint Expert Committee on Nutrition (Geneva, 9-18 November 1970).

Feeding the preschool child

The *ad hoc* Group on Feeding the Preschool Child met a second time in Geneva, in September, 1970. The report of the meeting was presented before the PAG. A brief note on the discussions of the *ad hoc* Group meeting was published in Bulletin No. 11. The PAG recommended that a consolidated report of the two meetings of the *ad hoc* Group be published as a PAG document. The document is under publication. Also, the manual on feeding infants and children with special reference to home-made weaning foods, prepared by Miss Cameron and Dr. Hofvander, was recommended to be published by the PAG.

The PAG recommended that *ad hoc* groups be created to consider a) regulatory and legislative aspects concerning protein-rich foods for special dietary uses and food for infants and b) the public health significance and nutritional implications of lactase deficiency and milk intolerance. In view of the other important subjects that require examination, the *ad hoc* Group on Feeding the Preschool Child was recommended to be continued with altered terms of reference and modification of membership to satisfy the new terms of reference.

Marketing

The report of the second meeting of the *ad hoc* Group on Marketing was presented. (A brief note on the meeting appeared in Bulletin 11.) The marketing guideline prepared by Prof. Wickstrom was accepted as a PAG guideline and recommended for publication. The PAG also accepted two statements, one a statement on "Marketing of conventional foods" and the other the revised Statement No. 5 on "Marketing and distribution of protein-rich foods". These are reproduced beginning on pages 26 and 19 , respectively.

Feasibility of FPC for developing countries. The report of the ad hoc Group meeting and the draft statement

The report of the *ad hoc* Group meeting and a statement on the subject were presented.

(A brief report on the ad hoc Group meeting appeared in Bulletin 11.) The PAG suggested modification of the statement to reflect some of the viewpoints expressed in discussion, especially with regard to the need for encouraging further studies to develop inexpensive methods of FPC production. It was also suggested that clinical experience on the use of FPC in the treatment of PCM should be included in the statement. A summary of the revised statement will appear in a future edition of the Bulletin.

PAG guideline on fish protein concentrate

The revised Guideline No. 9 was accepted and approved for distribution. The guideline is published elsewhere in this issue (page 13).

Field tests of nutrition intervention programmes

The document on "Field trials of nutrition intervention programmes" and an outline on "Evaluation of programme effectiveness", both prepared by PAG consultant Dr. Gordon, were considered. It was decided to circulate the document widely to experts and finalize the guideline at the next meeting after consideration of the various suggestions from the experts.

Areas for research and development in the field of edible proteins

The Group heard a summary of the comments and suggestions made by various experts and institutions on the draft circulated earlier and finalized a statement on the subject. It was decided that the list should be considered provisional and that it need not indicate any priority. The revised list (provisional) appears in this Bulletin on page 22.

Guideline on defatted, edible sesame flour and protein isolates

The draft guideline prepared by Dr. Parpia was discussed with special reference to development and availability of industrial equipment and available experience in countries other than India. Although aflatoxin contamination appeared to be a minor problem in this crop, it was believed that it was important enough to merit reference in the document along with relevant analytical methods. Though not definite, the possible role of selenium in connection with sesame should be considered further in the guideline. The Group requested Dr. Parpia to take these points and other suggestions into account and prepare a draft guideline for consideration at the December meeting.

Solvents

The PAG reconsidered its Guideline No. 1, issued in 1960, on solvents. Since the issue of the PAG Guideline No. 1 on "Solvents for use in defatting oleaginous food materials" there has been considerable documentation available on this subject. Therefore, the PAG recommended that the Guideline No. 1 be withdrawn forthwith and instead a statement briefly summarizing the specifications approved in the report of the Joint FAO/WHO Expert Committee on Food Additives (June 1970) be issued.

Microbiology and sanitation - draft guideline

The Group considered the draft guideline for microbiological tests for heat-processed dry granular high-protein foods which had been prepared by PAG consultant Dr. F. S. Thatcher, Ottawa, Canada and welcomed in particular the fact that it included sampling plans. The Group noted that this document is presently being circulated to specialists for comments. It recommended that the comments be noted before finalizing the guideline. The Group also urged that consideration be given to the need for recommending methods which can be applied in laboratories without access to more sophisticated facilities.

Once such a guideline is approved, the indications for microbiological examination contained in PAG guidelines relating to the composition of heat-processed dry granular products should be replaced by a reference to this guideline.

Meat analogues

The Group reviewed the present information on the production and the current experience in the use of the product and prepared a tentative guideline which will be circulated widely for further comments before adoption at the next meeting.

Documentation study on information service in the fields of edible proteins

The PAG heard the Secretary briefly review the developments since the last meeting. He listed some of the possible methods of approach which, though somewhat inadequate, are steps in the right direction. The Group was informed of the tentative offer by a well-known publisher to bring out an annual review publication in the edible protein field. The PAG endorsed this initiative by the publisher and recommended that the Secretariat cooperate with this project as appropriate.

After a detailed discussion a statement on the subject was prepared.

Protein from rapeseed and mustardseed

The brief document and informational material on this subject presented at the meeting emphasized the increasing attention being given to these potentially important protein resources, particularly in several countries of Northern Europe as well as Chile, Canada, India and Pakistan in the case of rapeseed, and India and Pakistan in the case of mustardseed. Since both crops contain a number of toxic or otherwise undesirable constituents (glucosides, erucic acid, etc.), research must be encouraged to develop methods for their elimination, and guidelines should be written to ensure toxicological safety. The possibility of eliminating such toxins by genetic manipulation should also be studied.

It was recommended that developments in this field be closely watched by the Secretariat, particularly those from industrial and governmental research centres, and that the subject be updated in a suitable document to be presented at a forthcoming meeting.

Milk intolerance and lactase activity

Recent studies have shown that in some apparently normal adult individuals, the intestinal lactase activity is low or absent and administration of lactose or relatively large quantities of milk causes abdominal discomfort and diarrhoea. While this condition has been observed in a small percentage of Caucasian adults, it is reported to be more common in Africans and Asians. However, several of the studies reported in the literature have been carried out as clinical investigations in hospitals on small groups of subjects. Also, information regarding the occurrence of this problem in children is meagre. The few reports that are available suggest that intolerance to milk is present in some otherwise healthy children in non-Caucasian populations, though other studies have indicated that it is not always possible to demonstrate a relationship between milk intolerance and intestinal lactase deficiency.

The PAG endorsed the views expressed on this subject at the meeting of the ad hoc Working Group on Feeding the Preschool Child, 14-18 September 1970 and felt the evidence is not sufficient to come to any conclusion regarding the extent, severity and public health significance of the problem in preschool children or mothers in the developing areas of the world. In view of the importance of the subject to child feeding and maternal nutrition and its nutritional implications, the PAG recommended that a study group be formed on the subject to meet and consider specifically the subject of "Milk intolerance - prevalence and nutritional implications". The study group will 1) undertake a critical review of the world literature on the subject to make an assessment of the problem and identify the gaps in knowledge and 2) draw up practical proposals for futher investigations to assess the public health significance. Some of the areas where more information is required are a) prevalence of milk intolerance in groups of populations in different geographic locations, using standard epidemiological techniques. The study should include subjects of different age groups and sex and attempt to correlate the extent of loss of enzyme activity and the degree of milk intolerance; b) development of suitable screening tests for use in the field; and c) the pathogenesis of the condition with special reference to the possibility of gradual adaptation to milk administration and reestablishment of tolerance.

Single cell protein - research and development

At present extensive research and development is taking place in many countries on the utilization of industrial production of single cell protein (SCP) biomass as a means of increasing protein resources. Recently, much knowledge has been accumulated on the use of new raw materials for SCP production, especially hydrocarbons, i. e., natural oil and gas. There appears to be a great possibility of using SCP as a feeding stuff for cattle and other farm animals, and it can be anticipated that SCP suitable for human consumption can be provided from purified hydrocarbon fractions. Research in this area is particularly promising due to the availability of large amounts of appropriate raw material.

The PAG considered reports presented to it by the Institut Français du Pétrole (IFP), and by the Kohlenstoffbiologische Forschungstation, Dortmund, on the production and use of Spirulina and Scenedesmus for protein production.

The Group considered the work on Scenedesmus interesting and the utilization of Spirulina promising. The Spirulina organism has been used as food by some population groups for many centuries without any recorded adverse effect. For this reason the Group encourages the research and development work conducted on this material by the IFP in Algeria and Mexico.

Studies reported to the Group by the Lord Rank Research Centre in England on the use of microfungi for food use were also considered important by the Group since the product is intended for human consumption in a textured form. The Group recommended, however, that more information on the nutritional value and on toxicological aspects of these products be obtained.

A detailed consideration of the entire subject was referred to the next session of the PAG's *ad hoc* Working Group on Single Cell Protein. It is clear to the Group that promising developments are taking place in these fields and that research and development work on all these organisms should be continued and expanded.

Mycotoxins

The PAG took note of the information placed before the Group on the problem of mycotoxin contamination of foods and its significance in human illness. The studies seemed to underline the need for further careful work to establish whether mycotoxins play a role in the causation of acute and chronic human illnesses.

It was recommended that the Secretariat obtain more information on this aspect from the different workers engaged on this problem and place it before the next regular meeting of the PAG so that the Group could examine whether a need exists for revising the recommended maximum levels for aflatoxin in foods.

The Group recommended that the earlier PAG guidelines for aflatoxin bioassay (Guideline No. 3) be withdrawn and instead the methods approved by the IUPAC be used in the future. (See AOAC, "Official Methods of Analysis", 11th ed., Chapter 26.)

Sunflowerseed protein

The nutritional potential and palatability of sunflowerseed foods as protein resources have unfortunately not been matched by the development of suitable processing technology necessary to achieve fuller impact of this potential for edible use. The background document before the PAG has suggested a tentative guideline for a suitable processing technology for preparation of defatted protein concentrate using standardized oilseed processing equipment and procedures. Suggestions related to quality, sanitary processing and control procedures are also presented. A major limitation of this technology is its inability to prevent undesirable darkening of the product due to oxidation of endogenous phenolic constituents. Information from the U.S.S.R. suggests that newly developed industrial procedures to achieve very thorough decortication will drastically reduce this color problem, since apparently the phenolic compounds (chlorogenic acid) are associated with the hull.

It was proposed that additional information concerning these new developments be obtained and made available to the PAG.

Report on Bogota meeting

The Group noted that a conference of paediatricians and representatives of the infant food industry was held in Bogota, Colombia, 5 and 6 November 1970 under the sponsorship of the Pan-American Health Organization, WHO and UNICEF, with FAO participating as an observer. The objectives of the conference were to emphasize the importance of prolonged breast feeding in developing countries, to consider tentative guidelines for the promotion of appropriate infant foods, to discuss the development of new low-cost, protein-rich weaning foods, and to consider the possibilities of public health and industry joint action. Recommendations for action to be considered are included in an "internal report" which has been issued for the use of the participants and their organizations.

The PAG urged the Agencies to follow up on the recommendations of the Bogota meeting and organize a second meeting in another region. The statement of FAO that it would be able to be a co-sponsor of such a meeting was welcomed. The PAG will cooperate by making documentation available and assisting in dissemination of information resulting from the meeting. Appropriate liaison should be worked out with the International Union of Nutritional Sciences (IUNS) and the International Union of Food Science and Technology (IUFOST).

The PAG was informed that the second meeting might be held in Eastern Asia toward the end of October, 1971. A brief report on the Bogota meeting appeared in Bulletin 11.

Specific subjects submitted by agencies for comment in the light of general policy and priority

The PAG stressed the urgency of modifying international legislation on patents in order to bring it in line with current needs for diffusion of innovations in the field of proteins of benefit to national development.

The PAG agreed to convene a small working group to evaluate a proposal on carob bean processing which had been submitted to the UNDP.

CHANGE IN SECRETARIAT

The PAG is pleased to announce the appointment of Dr. Max Milner, formerly of UNICEF, as Secretary, effective 1 July 1971. He succeeds the Acting Secretary, Dr. G. D. Kapsiotis, who returned to Rome on 21 June 1971 to resume his work as Chief, Protein Foods Development Group, Nutrition Division, FAO.

Dr. Milner had been Senior Food Technologist at UNICEF, United Nations, New York, for eleven years prior to joining the PAG Secretariat. Prior to that he was a Professor of Cereal Chemistry at Kansas State University for twelve years. In 1966, Dr. Milner served as Chief of Nutrition US/AID in Washington, D. C.

PROTEIN-RICH MIXTURES FOR USE AS WEANING FOODS

This guideline, Guideline 8, is a recommendation for the composition of weaning foods, including specifications for levels of protein, calories, fats, vitamins and minerals. Physical characteristics, flavour, taste and packaging requirements are also covered. The guideline was adopted by the PAG at its 18th Meeting.

The serious and widespread problem of malnutrition during the weaning period in tropical and subtropical countries and the inability of lower income groups to purchase sufficient animal protein foods or high-cost special children's foods calls for marketing of nutritious low-cost mixtures based mainly on vegetable proteins with admixture of other proteins where appropriate. In addition to low cost, satisfactory tolerance and acceptability on the part of the child and acceptability to the adult(s) responsible for providing the child's food are important factors. Of paramount importance, however, if the primary purpose is to be achieved, is the maintenance of minimal nutritional and sanitary standards, even though this may mean constraints in relation to cost.

Ideally, the protein food mixture should be a supplement which is patterned in accordance with the child's diet in the home and fills the gaps with respect to calories, proteins and other nutrients. In order to be certain that the minimal needs are covered even under unfavourable dietary conditions, the weaning food mixture should provide protein, vitamins and minerals corresponding to recommended allowances when consumed at the recommended level. The recommended daily intake of the supplement is usually of the order of 100g dry weight with a protein content of no less than 20%. If the recommended daily intake is less than 100g the content of protein and other nutrients should be correspondingly higher. These products should not be recommended for infants below six months of age unless they are specifically treated to ensure complete digestibility.

1. Level of protein

The provision of adequate protein generally presents the most difficult problem during the weaning period and special attention should be given to the quality and quantity of protein in supplementary weaning foods. The NPU value of the protein should be not less than 60 and preferably near 65 and correspondingly the PER, not less than 2.1 and preferably above 2.3 (casein = 2.5; the value for casein varies with different casein products and the strain of rat used). With protein of this nutritional quality, the level of protein in the supplementary food should be at least 20%. If the quality of the protein is higher the quantity can be reduced accordingly.

2. Calories

The mixture should provide as many calories as possible and this may be achieved by adding fat. Poorly digestible carbohydrate, including fibre, should be held to a practical minimum. The starchy portion of mixtures may be modified through various combinations of heat and mechanical processing or enzyme treatment, so that when prepared with water and ready for feeding, the food has minimal bulk, maximal protein availability and maximum calorie density.

3. Fat

Present knowledge does not permit specifying with certainty a dietary allowance for fat. Even so, it will be of great advantage to incorporate into protein-rich food mixtures as much fat as is technologically feasible without compromising the keeping qualities of the food. The fat will increase the calorie density of the mixture. A level of fat contributing 25% of calories to the mixture would be desirable. The linoleic acid content should be at least 1%. Without any addition of extra fat, the protein food may contain nearly 2 to 3% fat derived from the basic ingredients used in the formula. If the cost, including the need for special packaging to ensure adequate shelf life, is found prohibitive, the addition of food fat or oil when the mixture is prepared for consumption is recommended as a possible approach.

4. Vitamins and minerals

Protein-rich mixtures should be fortified with vitamins and minerals sufficient to satisfy recommended allowances. Special attention should be given to vitamin A, riboflavin, niacin, folate, vitamin B_{12}, ascorbic acid, vitamin D, calcium, iron and iodine. Minimal quantities of various vitamins and minerals as proposed in Section 6 are recommended. However, some adjustment in the light of local nutritional problems may be considered. There may be no need to provide additional vitamins or minerals as medication to the child if the high protein mixture is fed at recommended levels.

5. Physical characteristics, flavour and taste

Acceptability of formulated foods can be enhanced by modern industrial processing such as precooking and roller drying, extrusion cooking and enzyme treatment. The food mixture should be formulated and processed so that by the addition of minimal amounts of freshly boiled water or by boiling after adding water it is easily and quickly prepared as a gruel or porridge of proper consistency for feeding.

Consideration should be given to the processing of starchy components with amylases or by extrusion cooking which will a) reduce the cooking time in the home; and b) reduce the viscosity and water retention capacity, or "bulkiness", of the mixture, thus allowing the feeding of a more concentrated preparation. The addition of sugar to protein-rich food mixtures is permissible provided the cost is not unduly increased, since such an additive enhances acceptability. In general, however, the sweetening of the products should be carried out in the home. There is no evidence that sucrose intolerance is an problem of importance.

There is no need to add ordinary salt to the formulated weaning foods.

6. Guidelines for composition expressed on a dry weight basis

Component	Units per 100g
Protein	not less than 20g*
Fat	as much as feasible, up to 10g

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* This protein level assumes an NPU not less than 60 and a PER not less than 2. 1. If these values are higher the level of protein may be reduced accordingly.

Crude fibre	not more than 5g*
Moisture	preferably 5 - 10g
Total ash	not more than 5g
Acid-insoluble ash	not more than 0.05g
Vitamin A	1300 I. U. (as vitamin A palmitate, equivalent to 400mcg retinol)
Thiamine	0.3mg
Riboflavin	0.4mg
Niacin	5.0mg
Folate	0.2mg
Vitamin B_{12}	2.0mcg
Ascorbic acid	20mg
Vitamin D	400 I. U.
Calcium	300mg (as phosphate or carbonate)
Iron	10mg (as food-grade compound of adequate iron availability)
Iodine	100mcg (as iodate or iodide)

Note:
Under certain local conditions, the addition of vitamin B_6 (to approximately the level of thiamine) and alpha-tocopherol should be considered.

The values for vitamins and minerals are considered minimal, except in the case of vitamin D, where no further increase is desirable. The excess of each vitamin added during processing should be no greater than that needed to maintain label requirements over the expected shelf-life of the product.

7. Food additives

Use of excessive amounts of flavouring agents, including salt, sugar or other sweeteners, should be avoided. If any food additives are used, they should be those which have been cleared by the Joint FAO/WHO Expert Committee on Food Additives. The amounts used should not exceed the minimum necessary to produce the desired effect. Necessary information must be given on the label about the nature and quantities of food additives used in the product.

8. Standards and purity

8.1 The ingredients in the formula should meet the national and/or international standards with regard to purity. The FAO/WHO/UNICEF Protein Advisory Group has prescribed quality guidelines for the following:

a) Edible groundnut flour	PAG Guideline 2
b) Edible cottonseed protein concentrate	PAG Guideline 4
c) Edible heat-processed soy grits and flour	PAG Guideline 5
d) Fish protein concentrates for human consumption	PAG Guideline 9

8.2 Legumes and oilseeds may frequently contain tryptic inhibitors and other undesirable factors which must be reduced by processing before use in high-protein foods. Since all toxic factors may not be eliminated by processing, it is essential that only grain legumes which are nutritionally wholesome and toxicologically safe be used.

8.3 The preparation of a protein concentrate from oilseeds may require solvent extraction. Adequate procedures requiring food-grade solvents are described in a report by the Joint FAO/WHO Expert Committee on Food Additives (FAO Nutrition Meetings Report Series No. 48; WHO Technical Report No. 462). It is necessary that adequate methods of extraction using food-grade solvents be used to eliminate the dangers of toxicity.

8.4 Cereals, oilseeds and other source material to be used in the basic mixture may be contaminated with toxic moulds. The FAO/WHO/UNICEF Protein Advisory Group has reviewed this problem and issued a statement (PAG Statement 2) on the subject.

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* Crude fibre higher than this may be acceptable although it would require clinical testing.

9. Microbiological and sanitary standards
Separate PAG guidelines for microbiological and sanitary requirements will be issued shortly.

10. Packaging
Packages and the containers in which they are shipped should provide protection from the inroads of insects, microorganisms, moisture and contaminants. If foods are dispensed from bulk containers, proper sanitary procedures should be observed. Simple but effective information with respect to the correct use of the product should be on the package.

11. Shelf-life
The packaged product should remain acceptable for food use in terms of retention of palatability, nutritional availability and freedom from toxic or other deleterious changes for a period of six months under tropical conditions.

FISH PROTEIN CONCENTRATES FOR HUMAN CONSUMPTION

This draft guideline, Guideline 9, was approved by the PAG at its 18th Meeting. The guideline refers to nontraditionally preserved fishery products which have a protein content higher than that of raw fish. It distinguishes between type A, an essentially odourless and bland product, and type B, which may or may not be partly defatted and deodourized. The products may be produced from any fish or other aquatic animal or parts thereof suitable for human consumption. Type A should have not less than 75% protein; type B, not less than 60%. The fluorine content should not exceed 250 ppm, and the available lysine content should not be less than 6. 5% of the protein.

1. Product description

1. 1 Definition

Fish protein concentrate (FPC) is a stable product suitable for human consumption prepared from whole fish or other aquatic animals or parts thereof. Protein concentration is increased by the removal of water and in certain cases, of oil, bones and other materials.

Traditionally-dried or other traditionally-preserved products do not fall within this guideline.

1. 2 Types of fish protein concentrates

a) Type A products are essentially odourless and bland powders, usually of light colour, containing very low concentrations of lipids. Currently only FPC's produced by isopropanol or ethylene dichloride/isopropanol extraction meet type A specifications. FPC's prepared by aqueous extraction or by enzyme hydrolysis, presently only in laboratory production, may also fall into this category.

b) Type B products are often flavourful, have a higher content of lipid and may be presented in such various physical forms as powders, pastes or liquids, according to the consumer habits in the country for which they are destined.

2. Guidelines for processing and storage

2. 1 Raw material

FPC may be produced from any fish species or other aquatic animal or parts thereof suitable for human consumption. The quality of the raw material and the handling practices should be equivalent to those used for fish for processing for human consumption.

Before processing the fish may be preserved whole or in ground form by means of dehydration, chilling, freezing or by immersion in the solvent used for extraction. Fish for processing into FPC shall not contain any material not permitted by national legislation.

2.2 Processing

FPC may be prepared by extracting water and often lipids from the fish material in a continuous, semicontinuous or batch operation or by hydrolysis, enzymatic or other types, carried out by sanitary practices.

Different processing techniques are in use. Regardless of the processing technique, the high nutritive value of the fish protein should be maintained.

2.2.1 Extraction and separation. Extraction can be based on lipid extraction using a dehydrated raw material or it can be based on simultaneous dehydration and lipid extraction of raw, cooked or hydrolyzed fish or by separation of lipids from the hydrolyzed fish. Raw fish or parts thereof may be partially or wholly hydrolyzed either autolytically, by added enzymes or chemically, or by a combination of these methods.

2.2.2 Solvents. Isopropanol, ethylene dichloride, ethanol and hexane, either singly or in combination, have been used for extraction. The extraction solvents used should conform to the specifications for food-grade solvents prepared at the 14th Session of the Joint FAO/WHO Expert Committee on Food Additives.

2.3 Packaging materials

Any inert food packaging materials which have sufficient strength to withstand normal handling during storage and shipment and which protect the product from recontamination, air, moisture, light and insects could be used.

2.4 Storage

Storage conditions should be such that direct exposure to heat, and moisture in the case of dry products, is avoided and controls are adequate to prevent infestation, rodent attack and contamination of the product.

3. Quality characteristics of the finished products

3.1 Composition

	Type A	Type B (powders only*)	Method of Analysis
Moisture	not more than 10%	not more than 10%	(1)
Lipids	not more than 0.5%	no limit	(2)
Protein	not less than 75%	not less than 60%	(3)
Total ash	not more than 15%	not more than 20%	(4)
Ash (acid-insoluble)	not more than 0.5%	not more than 0.5%	(5)
Fluorine (as F)	not more than 250ppm	not more than 250ppm	(6)
Available lysine	not less than 6.5% of protein	not less than 6.5% of protein	(7) or (8)

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* No specification is attempted for other type B products.

3.2 Solvent residue
The solvent residues should not exceed those compatible with good manufacturing practice.

Reference is made to the report of the Joint FAO/WHO Expert Committee on Food Additives (FAO Nutrition Meeting Report Series No. 48; WHO Technical Report No. 462) and the accompanying monographs on specifications and methods of analysis including those for determining residues in food.

3.3 Organoleptic characteristics
a) Type A shall not have more than a faint odour and taste when moistened with boiling water in a closed container.
b) For type B no specification is established, since these products often have a wide range of odours and flavours.

3.4 Stability
a) Type A shall show no discernible deterioration in protein quality and no evidence of spoilage or adverse changes as judged by the development of flavours and odours when stored in a moisture-vapour-proof packaging material for 6 months at 40°C (104°F).
b) Type B shall show no discernible deterioration of the protein quality when stored in a manner and for a period appropriate in relation to the intended use.

3.5 Hygiene
It is recommended that the products be prepared in accordance with the Recommended International Code of Practice - General Principles of Food Hygiene prepared by the Codex Alimentarius Commission.

3.6 Microbiological examination
Microbiological requirements will be given in a PAG guideline to be issued in the near future. Until such a guideline is approved, the requirements indicated in the PAG draft suggestion (PAG Document 2.8/26) may be followed.

3.7 Safety
No food additives other than those approved by the Joint FAO/WHO Expert Committee on Food Additives should be used.

Toxicological and clinical assays should be conducted according to PAG Guideline No. 6: "Pre-clinical testing of novel sources of protein", and Guideline No. 7: "Human testing of supplementary food mixtures".

4. References

1. Association of Official Analytical Chemists. 1965. Official methods of analysis. Tenth ed., paragraph 18.006. AOAC, Washington, D.C., U.S.A.
2. Ibid., paragraph 22.037.
3. Ibid., paragraph 2.044.
4. Ibid., paragraph 18.008.
5. Ibid., paragraph 12.007
6. Ibid., paragraph 24.029
7. Blom, L., P. Hendricks and J. Caris. 1967. Determination of available lysine in foods. Anal. Biochem. 21:382-400.
8. Carpenter, K.J. 1960. The estimation of available lysine in animal-protein foods. Biochem. J. 77:604.

THE NATURE AND MAGNITUDE OF THE PROTEIN PROBLEM

The following revised statement, Statement 3, was adopted by the PAG at its 18th Meeting.

Large segments of the population in developing countries suffer from the effects of protein deficiency for want of adequate quality and quantity of protein in their diets. Projections based on current trends in demand and supply indicate that unless these trends are changed, the protein gap will become increasingly serious in years to come.

The nature and magnitude of the protein problem poses the greatest threat to vulnerable groups, particularly preschool children and nursing mothers, even and expectant and nursing mothers, even when food balance sheets and family dietary surveys fail to show a deficiency. Moreover, agriculturally and economically, adequate protein of good quality will be more difficult to provide for a rapidly growing world population than the needed calories. The reasons for the existence of a protein problem must be understood clearly if serious errors in formulating national agricultural and food policies are to be avoided and grave consequences to the health and future of the underprivileged of all countries averted.

1. Complexity of the problem

WHO has recently reviewed (WHO/FAO Joint Expert Committee on Nutrition, Geneva, November 9 to 18, 1970) the information available on the prevalence of protein-calorie malnutrition (PCM) from the limited number of surveys which have been conducted throughout the world in recent years. The prevalence of severe PCM is reported to range from 0 to 7.6% in children below 5 years while the prevalence of moderate forms of PCM range between 4.4 and 43.1%. It is clear from the above information that it is difficult to provide at the present time even a rough estimate of the total number of malnourished children in the world, although it is obvious to everyone concerned that malnutrition in its different forms is widely prevalent in most developing countries. For the majority of young children in developing countries the degree of protein-calorie malnutrition is sufficient to retard their physical growth and development and increase their susceptibility to infection. For some, the deficiency is early enough and sufficiently severe to influence the brain development and function and subsequent learning behaviour as well.

2. Fallacy of conclusions drawn from per capita data

The overall per capita availability of protein cannot be used as an indicator of the extent of protein-calorie malnutrition in a country because individual protein intakes may bear little relationship to physiological needs. If they can afford to do so, most persons will consume more protein than they require, often by a factor of two or three. Calorie intakes, on the other hand, must bear a much closer relationship to actual requirements. It is noteworthy that according to FAO food balance sheets, Chile and Sweden have about the same per capita protein intake, yet protein-calorie malnutrition is a very serious problem in Chile and not at all in Sweden.

It is well known that protein intake and quality vary greatly with socioeconomic class. Whereas upper-and middle-income groups usually have a satisfactory protein intake, low-income groups, which represent a large percentage of the population in a developing country, often have an intake which is very low. Protein malnutrition is frequent in urban and semiurban low-income groups which rely completely on the market for their food supply, and also in rural areas among low-income groups growing most of their own food supply under marginal conditions or working as labourers. Even within socioeconomic classes there are wide variations in protein intake among families.

Even where family intakes of protein and calories appear adequate those members of the family with special needs, the preschool child and the pregnant and nursing woman, frequently receive less than their proportionate share for a variety of social and cultural reasons. Thus the problem of protein-calorie malnutrition is also one of maldistribution which cannot be estimated from food balance sheets or data on overall per capita availability of nutrients.

There are other major limitations to conclusions regarding the relative adequacy of protein and calorie intakes of individuals in developing countries. This is because their physiological requirements for protein are increased by frequent episodes of infectious disease which cause both a decrease in intake and an increased metabolic loss of protein from the body. If this cannot be compensated for by higher than normal intakes of protein after recovery from the disease episode, progressive protein depletion occurs with each episode. In young children this is a primary factor in the occurrence of the serious clinical form of protein deficiency relative to calories known as kwashiorkor. In addition, parasitic infections and diseases causing diarrhoea decrease intestinal absorption of dietary protein as well as other essential nutrients.

The combined effect of these factors is to increase the per capita need for protein in developing countries, particularly among preschool children who suffer from frequent bouts of diarrhoea and other infectious diseases and harbour intestinal parasites of different kinds. Thus the FAO/WHO recommended allowances for protein based on the needs of individuals free of disease cannot be applied indiscriminately to the populations of developing countries. It has been suggested that the recommended allowances for preschool children in developing countries may need to be increased substantially over those for advanced countries until improvements in environmental sanitation, personal hygiene and preventive medicine reduce the burden of infectious disease. While changes of this nature and magnitude will require many years, much damage to the health of the preschool child may be prevented immediately by more adequate diets.

Dietary intakes compared with recommended dietary allowances for preschool children in developing countries may sometimes suggest calories to be more limiting than protein. Nevertheless, for the reasons cited, protein may still be the most critical deficiency in the diet and clinical signs of protein deficiency occur in some children. Moreover, the prevention and treatment of all forms of protein-calorie malnutrition in children usually require more concentrated sources of protein in relation both to calories and to total bulk than provided by existing diets. Conclusions as to the relative significance of combined protein and calorie deficits for all age groups are also confounded by the fact that individuals can adjust to calorie deficit by reducing their activity while their protein requirements are likely to be increased under the same circumstances because of the factors described above. In addition, it is important to recognize that any significant degree of calorie deficiency can exacerbate a deficiency of protein because the protein in the diet is then used in part for energy purposes. This is a significant factor in the occurrence of the various forms of protein-calorie malnutrition in children.

It is for all of these reasons that the nature and magnitude of the problem of protein relative to calories cannot be predicted from overall food availability data. It has been suggested in the FAO Indicative World Plan that even when protein supplies are 20% above the average national requirement, a significant part of the population may still have diets deficient in protein. The average per capita protein supply needed to avoid protein malnutrition will obviously vary considerably with the circumstances. It will tend to increase for the developing countries as incomes and effective demand rise.

Prices of protein-rich foods are likely to rise considerably in many countries, especially for animal products. Such foods will, therefore, be even more outside the reach of the underprivileged groups in the years to come, unless national food and nutrition policies are established to provide for vulnerable groups.

3. Future prospects for protein supplies

Great progress has been made in increasing cereal production. The Green Revolution has proved in many parts of the world that the introduction of high-yielding varieties, price incentives and greater inputs can help to obtain substantially larger crops. The Green Revolution must now be spread to other plant species and its techniques should be applied by more farmers. It needs to be accompanied by better storage, handling, distribution, marketing and utilization.

There is particular concern that legume production in some countries is decreasing because the new cereal varieties are more profitable to grow. Since legumes have traditionally provided the additional protein needed in predominantly cereal diets, this trend is ominous and must be reversed.

Successful efforts to improve the protein value of the new high-yielding cereals can also be a major factor in solving the protein problem. The introduction of opaque-2 and floury-2 maize varieties with their greatly improved protein quality, could, for example, significantly improve the protein quality of diets of maize-eating populations. The development of high-yielding varieties of rice and wheat which are also high in protein value would benefit still larger numbers of people. It should be possible in the future to tailor plant varieties to meet man's protein and other nutritional needs much better than at present.

Similarly, the improvement of cereal-based diets with small amounts of protein concentrates or by fortification with the limiting essential amino acids can compensate for the qualitative deficiencies of cereal protein and have an impact on the protein problem. Developments such as glandless cottonseed free of the toxic pigment gossypol and rapeseed lower in erucic acid indicate the potential of plant breeding to increase the availability of protein foods by eliminating toxic or undesirable substances which hamper their use. Processing developments may have a similar effect.

Future availability of protein for human consumption will also depend on increased production of grain legumes and greater utilization of oilseed meals for human consumption. The development of more efficient breeds of poultry and swine and more efficient feeding, including the use of urea as a nitrogen source for cattle and other ruminants, are also promising and important.

A major factor in food shortages and the supply of both protein and calories is the enormous loss and spoilage due to insects, rodents, birds and microorganisms. It is necessary to prevent undesirable species with much higher reproduction rates from destroying much of the present and future food production. Storage, processing and distribution techniques must also be improved to ensure maximum nutritional benefitsfrom food supplies. These measures would help to augment food supplies significantly, especially in developing countries where they can have a large and immediate impact. The war on waste must begin in the fields while the crops are being grown and be continued until the food is used by the consumer.

4. Action required

There is no simple solution to the protein problem. Indeed, its complexity is such that many approaches must be explored to meet the various requirements of different regions, particular countries, different areas within countries, both rural and urban, and different sections of the community, particularly, of course, the vulnerable groups. Moreover, as emphasized above, aggregative and per capita data are not a sufficient basis for the formulation of national policies concerned with either the adequacy of protein supplies or the health of vulnerable groups.

Action is necessary on many fronts: through increased production of protein from agriculture and fisheries; through reduction of losses in the field during harvest, during storage, distribution and utilization of the supplies; through the development of protein-rich food mixtures and modernization of food preservation and processing industries; through education and training, including consumer education; through a broad programme of environmental sanitation and prevention of disease, especially in childhood;

through a sound programme of research and development; and through studies providing better information on dietary intake and on the factors which determine it. All this must fit into national plans for economic development, aimed at increased purchasing power and social development. Where practical, assistance to vulnerable groups through institutional feeding or other welfare programmes should be included in such plans.

The solution of the protein problem requires a clear governmental policy and its effective implementation through coordinated interdepartmental action and greater integration of the efforts of international agencies, foundations, bilateral programmes and research institutions. A systems analysis approach may assist in giving a better understanding of the problem and also assist in the formulation of a national policy and programme.

MARKETING AND DISTRIBUTION OF PROTEIN-RICH FOODS

Based on the report of the two meetings of the _ad hoc_ Group on Marketing, the PAG at its 18th Meeting in Rome, Italy, 9-12 February 1971, adopted the following statement, Statement 5, on Marketing and Distribution of Protein-Rich Foods.

1. _Training needs_

The PAG noted that a number of specific training courses, seminars, etc., have been arranged to instruct or brief individuals working in marketing projects at various levels. However, a specific programme for educating individuals prepared to assist at the highest management level in the development and marketing of protein-rich foods does not appear to exist and government arrangements in this particular field of marketing are lacking.

PAG Guideline 10 on Marketing of Protein-Rich Foods to Improve Protein Nutrition brings into focus the unique character of nutrition-oriented marketing problems. By the very nature of the marketing process the disciplines involved are many and varied. A truly interdisciplinary approach is essential and a properly trained individual must be aware not only of the technological and economic aspects of the problem but also be sensitive to its social and political content. Only individuals who have received this type of training can be expected to develop the choice of strategies which offer solutions acceptable to diverse components of the marketing chain.

The PAG recommends that consideration be given to the establishment of marketing training schemes. At least five levels of training are necessary to prepare individuals who will function in different parts of marketing programmes.

1.1 Programme manager level

At this level the executive by virtue of training, experience and special interdisciplinary sensitivity is prepared to advise on all aspects of the problem in the best consulting sense. He has had field experience, appreciates the need for acceptability of ideas and procedures and has a capacity for relating to different situations. To meet this need it appears essential to select qualified individuals and subject them to special courses which would combine nutrition aspects with actual business and operational aspects

1.2 Project operations manager level

This individual might be identified as

"brand manager" in large industrial marketing organizations. He appreciates the variables that must be considered and the data to be gathered and is prepared to participate in field projects.

1. 3 Marketing and sales management level
These individuals have sales ability but are trained to appreciate interrelations with malnutrition problems, the unique character of the products and the context in which they are promoted and distributed.

1. 4 Salesmen and similar levels
These individuals should be given sales courses and product knowledge. This training should be tailor-made to suit the specific purpose.

1. 5 Nutrition operations
This training should be oriented towards the development of a new and socially-oriented discipline, nutrition operations, in which the needs and interests of the consumer, at all economic levels, are considered uppermost.

The group discussed the availability of training programmes or courses designed for these various levels. Generally speaking, formally-organized courses are not available, at least for levels 1. 1, 1. 2 and 1. 5. Seminars and short-term courses may be adequate for levels 1. 3 and 1. 4. The value of training "under stress" is emphasized as well as that of training under competitive conditions which make distinctions between success and failure clear to the trainee. Intern training programmes are not particularly feasible unless they are properly staffed and financed and built into the project from its inception.

1. 6 The PAG makes the following recommendations
1. 6. 1 As soon as possible, a document should be prepared for consideration by the PAG which will extract from FAO's experience and other data provided by interested groups and individual ideas, suggestions and experiences related to training of personnel for marketing disciplines. From this document a curriculum should be prepared for each of the levels of training described.

1. 6. 2 A second document should then be prepared in the nature of a proposal for a pilot training programme to be conducted at all the levels indicated above. The proposal should cover the mechanism of selection of candidates, the number of trainees in the pilot programme, the nature and duration of the training and the financing requirements in terms of both cost of the training and cost of maintenance of trainees.

1. 6. 3 These documents should be circulated to training institutions, including business and professional schools, as well as to potential sources of financing such as national and international agencies and foundations to invite comments on both content and financing interest, preferably on a joint basis. The objective of this is to get the pilot training programme implemented.

2. Research needs
The PAG considered the research activities which would provide an analysis of continuing nutrition-oriented marketing projects and which may serve to improve marketing techniques in the future.

The PAG concluded that there are a great many fields where research should be undertaken; such research should aim at better description of the market processes, better methodology for project planning and market analysis, and improvement of techniques for marketing activities.

2. 1 The PAG makes the following recommendations
2. 1. 1 Ongoing marketing projects in the field of protein-rich food, whenever possible, should provide for built-in evaluation of these activities and make the experiences generally available by early documentation.

2.1.2 Universities and research institutes should consider studying marketing processes in developing countries and especially the introduction and distribution of protein-rich foods.

2.1.3 The possibilities of establishing one or more facilities for research in protein food marketing and related subjects of nutritional concern should be explored. These might be part of existing research organizations or other institutions, preferably in one or several developing countries. Such facilities might be established with the support of UNDP. This could take the form of establishing descriptive research centres which would collect and disseminate periodically, in an easily accessible form, experience gained in this field. There is also a need for experimental marketing research centres which would engage in active experimentation as regards different approaches to the marketing process.

2.1.4 The PAG should urge that existing projects make their experience and material available to outside researchers from such institutions as mentioned under 2.1.2 and 2.1.3.

3. Enterprise structures

Where marketing schemes are planned for protein-rich food programmes, there may often be a need for the development of enterprise structures different from those which are in conventional use. Much innovation has been displayed in the design of several such schemes by various United Nations Agencies. Presently, in a number of countries, cooperative or government agencies are involved in production of protein-rich foods, but commercialization and market expansion sometimes suffer because of lack of marketing skills.

3.1 The PAG makes the following recommendations

3.1.1 Encouragement of joint-sector (public-private) partnership may be a potentially useful way of encouraging the private sector to develop a consumer market. Such partnerships might supply institutional or equivalent sales to serve as supporting functions, especially during the early stages of market development. These could also serve to secure lower costs of the raw materials as well as promotional and educational support. Such partnerships might also stimulate the use of existing distribution systems for new protein products, thus bypassing the cost and personnel development involved in creating new distribution systems. Experience demonstrates that some type of joint-sector cooperation is often essential to the success of nutrition improvement at all levels.

3.1.2 The organization of food enterprise associations which include membership of both private and public sector representatives is a promising device and should be encouraged. Experience has shown that such organizations can help to provide a platform for discussion among concerned groups, encourage joint activities which reduce development costs to individual members, create a climate of urgency for nutrition improvement, lead to more effective marketing structures by information exchange, and, by inviting extended dialogue on mutual problems, achieve new and effective enterprise structures between private and public sectors.

3.1.3 A compilation should be prepared of descriptions of joint-sector and other novel enterprise structures which have been or are being tried in various areas. This document can well be based on the notes furnished by FAO (PAG Document 2.22/20). Circulation of such a document in the field will provide exposure to effective and promising ways of cooperation

4. Institutional feeding

In considering improvement in the consumption of protein-rich foods, the PAG feels that increased attention should be paid to the possibilities which institutional feeding programmes offer. In order to develop an effective strategy, adequate attention should be given to the relationship between institutional and commercial programmes, as well as to the costs and benefits involved in institutional feeding.

4.1 The PAG makes the following recommendations

4.1.1 In developing and expanding institutional feeding programmes, care should be exercised that a disincentive to local agricultural or industrial production or other marketing efforts is not created and that disruptions in internal and international trade are avoided. Institutional feeding programmes should therefore be designed as an integral part of development plans.

4.1.2 Attention should be given to developing a comprehensive methodology for evaluating the costs and benefits of institutional feeding programmes, recognizing that evaluating the benefits of improved nutrition presents particular problems, as a number of factors involved are difficult to measure.

4.1.3 In order to determine the role of institutional feeding programmes within a general strategy for improving nutrition, detailed studies should be conducted of ongoing projects which would endeavour to measure more precisely the costs and benefits of such schemes.

4.1.4 Noting the experience of the WFP in institutional feeding, it is suggested that this Programme should be approached to assist in identifying and weighing the variables involved in determing the costs and benefits of different types of feeding programmes and to provide details on the costs and benefits of the feeding programmes it is assisting.

4.1.5 More use should be made of the WFP as an aid in channeling the produce of developing countries, including protein-rich foods, into nutrition programmes for vulnerable groups. In order to make effective use of such commodities, WFP may need to secure futher technical assistance from the United Nations Specialized Agencies for project formulation, implementation and evaluation.

THE WORLD PROTEIN PROBLEM: RESEARCH AND DEVELOPMENT NEEDS

The following revised statement, Statement 12, was adopted by the PAG at its 18th Meeting in Rome, February 1971.

With the possibility in view of a wider funding or research in relation to the World Protein Problem, the Protein Advisory Group has drawn up the following list of major areas for research and development studies which are of broad significance and warrant further attention. Much of the work involved will best be carried out in the developing countries themselves provided that the necessary facilities, especially with regard to research leadership, are available.

It is difficult to indicate relative priorities between the various items on this list, partly because priorities will differ in relation to the needs of particular countries and regions and partly because of the wide range of disciplines involved. Insofar as particular research and development establishments are concerned, their own specialization will determine the areas of particular interest. At the central planning level, the national policies and priorities of governments will dictate priorities.

Affecting many of the areas referred to below is the important matter of securing the transfer and application of existing knowledge to the points in developing countries where it is needed; from this follows a requirement to study the obstacles in the way of such transfer and to find ways of overcoming them.

It may be mentioned that directing attention to the research and development problem relating to protein-calorie malnutrition may provide a valuable opportunity, particularly for developing countries, to bring in areas of scientific and technological expertise not previously employed.

The International Agencies can play a major role in coordinating the research potential of both the more and the less developed countries and in focusing attention on the major issues of the protein problem.

1. Protein production

1. 1 Agricultural production of plant protein

1. 1. 1 Plant breeding of cereals, legumes, roots and other varieties

a) which are high in both quantity and quality of protein as well as in total yield;
b) which have minimum content of toxic materials;
c) which provide materials technically suitable for storage and processing;
d) which are acceptable to the consumer and food processor.

Attention in breeding studies should also be directed to the improvement of crops for cultivation in different environments and in areas of developing countries where intensive agricultural techniques including irrigation cannot yet be introduced. Before starting plant breeding it may be necessary to carry out fundamental botanical and genetic investigation of existing or potential food crops, particularly in relation to nutritional value, toxicological factors and overall yield.

1. 1. 2 Improvement of tropical pastures and fodder crops.

1. 1. 3 Securing supplies of high-quality seed of improved varieties with special emphasis on

a) agro-ecology studies on seed production;
b) development of seed testing methods for the above crops growing in the tropics;
c) development of seed storage under tropical and subtropical conditions.

1. 1. 4 Control of pests of growing crops by biological and other means.

1. 2 Production of animal protein

1. 2. 1 Land animals. Work on animal breeding, feeds and nutrition using different types of animals, including those indigenous to different regions and including consideration of the introduction and adaptation of animals to different regions, with a view to obtaining improvements in such matters as

a) quantity and quality of protein yield;
b) efficiency of feed conversion and utilization of new types of feeds including the use of urea, ammonia and other synthetic chemicals and also molasses and other by-products or hitherto wasted plant materials;
c) data available on the nutritive value of feeds and nutrient requirements of animals;
d) control of zoonoses and other pathological conditions detracting from the growth or feed conversion efficiency of animals.

1. 2. 2 Aquatic animals. Studies with a view to obtain improvements in

a) fish farming in those areas where it can be economically viable;
b) food use of marine resources not traditionally used for food;
c) productivity of artisanal and subsistence level fisheries;
d) means of replenishing the trophic chain;
e) processing and packaging to increase time-distance distribution;
f) utilization and preservation of fish quality;
g) methods of protection of fish against the effects of pollution.

1.3 Production of single cell protein, including yeasts, fungi, algae and bacteria.

Studies
a) to obtain, by appropriate production methods, products suitable for animal feeding;
b) to obtain by further production conditions or treatments or by additional processing, products containing minimum amounts of nucleic acids and other potentially harmful materials, which may then be suitable for human consumption;
c) to select new strains of microorganisms for improved production characteristics;
d) to determine minimum scale for economic production;
e) to discover ways of utilization of low-cost materials that are wastes or are otherwise not efficiently utilized;
f) to determine appropriate standards of quality, taking into consideration the eventual use to which the product is to be put.

1.4 Industrial production
Study of routes to protein components (amino acids and peptides) and of nitrogen sources for protein biosynthesis.

1.5 Price policies
Support and subsidy programmes as a means of encouraging increased production and consumption of crops and animal products of high protein content. Other means of increasing the economic attractiveness of diversification towards such commodities.

2. Protein utilization

2.1 Handling and storage of crops and processed foods

Studies directed to counteract or minimize
a) losses due to pests (rodents, insects, microorganisms, etc.) under conditions found in developing countries;
b) mycotoxin contamination;
c) effects of oxidation or other chemical spoilage reactions;
d) physical losses or damage in handling or processing.

2.2 Improved processing
a) of oilseeds, legumes, fish and other raw material to yield safe preparations, high in good quality protein, and free of unacceptable amounts of toxic or undesirable factors;
b) towards enhancement of protein status of such concentrates by addition of limiting amino acids.

2.3 Food manufacture
a) Methods of manufacture of weaning foods and other protein foods based totally or in part on indigenous raw materials, taking into account as appropriate local concepts of feeding;
b) upgrading of production methods in developing regions for locally consumed foods including process and product development and packaging and distribution technology to assure protein content, quality and stability. (In both aspects, the needs of urban and rural areas may need to be distinguished).

3. Food quality appraisal and food analysis

a) Acquisition of more exact data on food composition and variations in composition;
b) Improvement and standardization of methods for determination of protein quality and quantity by chemical or biological means. This needs to go beyond determination of protein quantity and amino acid pattern, to cover digestibility and availability;
c) Assessment of chemical and biological assays for nutritive value in relation to tests with humans.

4. Food consumption levels, habits, acceptability and distribution

4.1 Surveys of household food consumption patterns. Factors responsible for differences in consumption levels within and between social groups, such as status, income, settlement pattern, etc.

4.2 Evaluation of consumption patterns with time and factors influencing the change.

4.3 Anthropological, sociological and psychological factors leading to food choice and to changes in food habits.

4.4 Marketing of conventional and unconventional protein foodstuffs, with particular reference to factors impeding distribution to vulnerable groups.

4.5 The role of institutional feeding programmes in the supply of protein foods to the vulnerable groups; interrelationship between commercial marketing and institutional programmes.

4.6 Methodology of consumer education with special reference to meeting the needs of the vulnerable groups.

5. Physiological, clinical and epidemiological studies

5.1 Physiological requirements for protein under different environmental and stress conditions, including further studies of the relationship between protein and other nutrient requirements, particularly calories.

5.2 Study of the extent of malnutrition and its relationship to the incidence of infections. Determination of specific means of dealing with infection and parasitism on a short-range basis through nutrition intervention.

5.3 Search for better biochemical, anthropometric and other indicators of malnutrition.

5.4 Effect of malnutrition on mental development.

5.5 Effect of nutritional status and particularly protein levels on working efficiency.

5.6 Relationship of maternal nutrition to foetal development.

5.7 Study of trends in breast feeding.

5.8 Effect of school feeding on learning performance and other attributes of children in developing regions.

5.9 Relationship of birth interval, and therefore family planning, on nutritional status of the preschool child.

5.10 Determination of means of encouraging family planning through nutrition intervention.

5.11 Biochemical verification of the value of locally-produced infant foods in comparison with milk formulas.

5.12 Determination of the benefits of new foods to nutrition status through longitudinal studies or other experimental procedures; development of guidelines for the evaluation of food products and processes designed to promote community nutritional status.

5.13 Epidemiology of nutritional anaemias.

6. Economic aspects of malnutrition

6.1 Methods available for estimating the cost of malnutrition and benefits likely to be obtained from food and nutrition programmes.

6.2 Studies of strategies for dealing with the protein problem at national and international levels and of ways of choosing between alternative procedures.

6.3 Interaction between general economic development and protein-calorie malnutrition.

MARKETING OF CONVENTIONAL FOODS

The PAG, at its 18th Meeting in Rome, February 1971, considered the subject of marketing of protein foods. The PAG based its deliberations on the findings of an ad hoc Working Group. The following statement, Statement 14, was adopted.

It is well recognized that at the present time and in the forseeable future, conventional foods will play by far the major role in meeting the protein needs of the world's population. In the efforts to achieve adequate protein nutrition, steps must be taken not only to improve the quantity and quality of protein foods but also their effective marketing.

Fully recognizing what has already been accomplished and also FAO's leading role among the United Nations Agencies in this field, the PAG makes the following recommendations:

1. In the formulation of strategies, the United Nations system of organizations should continue to give careful attention to the crucial role of marketing improvement programmes and should urge governments to strengthen their activities in this field.

2. Higher priority should be given to improving marketing systems and to financing marketing activities, including transport, storage, preservation, distribution, processing, promotion, sales, etc. More attention should also be given to incentives to farmers and fishermen, to increase production and to improve quality and to the removal of legal and other disincentives hindering the application of modern marketing methods.

3. The main principles expressed in PAG Guideline No. 10 on Marketing of Protein-Rich Foods in Developing Countries applies also to the marketing of conventional protein foods. This guideline will be published shortly; it is not available at this time.

POPULAR PARTICIPATION AND COMMUNITY INVOLVEMENT IN FOOD PROGRAMMES

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This paper was submitted as a background document, PAG Document 1.17/4, for the 18th PAG Meeting.

The increasing application of science and technology to food production and processing has now made it possible to envisage a future for mankind free from hunger; a future in which to provide an adequate supply of nutritious food for human consumption is within the capability of the world community. With the "green revolution" on land, the food potentials of the ocean and the possibilities of converting mineral resources such as petroleum to food are hopeful signs for the future.

The scientific and technological achievements in food production have been accompanied, however, by a growing awareness of the social and cultural problems that are connected with changing the quality or quantity of food as the ultimate objectives of food improvement programmes. There is a vast amount of accumulated evidence indicating that the success of these programmes depends to a large measure upon the extent to which they are formulated and planned within the context of the social and cultural conditions of the target population.

This short paper is an attempt to point out that popular participation and community involvement can be utilized as effective strategies to relate food improvement programmes to the social, economic and cultural characteristics of the target population, and thereby strengthen the effectiveness of these programmes in the alleviation of hunger and malnutrition. An effort is made to define popular participation and community involvement in order to establish their role in the main activity areas of food programmes; namely, production, distribution and consumption. The major social problems and constraints are pointed out for each area, followed by a discussion of the possibility of easing them through a closer involvement of the target population in planning, decision-making and implementing food programmes.

Definition

A community is generally regarded as a closely-knit social unit having certain shared values and interests which strongly govern the behaviour of its members within the unit and their responses to external stimuli. A community also possesses an inner structure and institutional arrangements through which the members, acting together, can accept or reject changes and make decisions which influence their individual or collective life. In this context, popular participation and involvement will take place when the structure and institutional arrangements in the community provide channels for these processes to take place, ultimately affecting the shared values and interests of the members.

Food improvement programmes, touching as they do on the basic values and interests of the community, have therefore to seek various measures and strategies by which the community can be closely involved in adopting and implementing the programme. In operational terms, this implies that: a) the community must become conscious of the food problem; b) alternative means to solve the problem must be considered; c) a decision has to be taken on the best course of action in terms of the prevailing conditions; and d) community resources must be mobilized to implement the programme.

Two of the above elements need further clarification. Consciousness of a problem entails seeing the object of interest in a larger context and being aware of its place in a wider frame of reference. Thus, becoming conscious of food as a problem is looking at food not only as a substance satisfying a physical urge, but also as a social product in relation to the totality of human values and needs. Mobilization is a process whereby unutilized and underutilized community assets are organized and brought to bear upon the solution of a problem, food in our case. The assets of a community include its natural resources as well as its manpower, its institutional arrangements and the stock of knowledge available at any point in time. The community's stock of knowledge includes its collective experience with reality and its evaluative interpretations in the community's historical past, in its present conditions and in relation to ideals and goals of the community incorporated in its social and cultural values (1).

Food production

The social and cultural problems affecting the introduction of new food crops and the agricultural improvement of food have long been recognized in the abundant literature dealing with modernization and growth of agriculture in developing countries. Some of these are related to individual attitudes towards change, some deal with the institutional barriers that inhibit innovation, and others deal with structural limitations on individual ability to bring about change and improvement. Examples range from attitude to work and fatalism, to political and economic institutions which only help the maintenance of the status quo, and segregation and discrimination against certain groups, excluding them from opportunities that might help to bring about self-improvement, self-determination and change. Whatever the origin of these social conditions, changing them constitutes a major goal for developing countries. Case histories of community development and agricultural extension programmes in these countries, as well as in the United States, show how popular participation and community involvement have been able to alleviate these conditions. The central theme of these programmes is an educative process in which members of a community become aware of their needs, increase their general and technical knowledge to meet these needs, and bring under community control unutilized or underutilized assets, through decisions arrived at collectively in farmer organizations, village councils, village societies and similar local institutions. In producing food for the market, the introduction of new varieties of wheat and rice, building of storage facilities through community efforts, establishment of cooperatives and construction of feeder roads are only a few examples. In producing for home consumption, the introduction and improvement of poultry and vegetable gardens, and the encouragement of participation by all family members in these activities, have provided material for major case histories. Furthermore, a comparison of examples of success and failure in these programmes indicates that when some of the factors necessary for popular participation and community involvement, such as knowledge of cultural values and historical experience of the community, have been overlooked, the experiment has resulted in failure, despite apparent success at the beginning of the programme (2).

Since the major emphasis of food production and improvement programmes has been commercial production, the target population has usually been producers already in a position of being a major factor in production, and consequently effective participation has been achieved only by those who could afford the extra risks involved in putting the new knowledge into practice. These include purchasing new seeds and fertilizers, buying or hiring tractors, investing in cooperatives and applying for adequate loans, and taking the social and economic risk of changing old practices (3). The share of the migrant labourer, the sharecropper and the tenant farmer has not increased proportionally, in cash or in kind, so as to solve the problem of their hunger. As the number of people involved in agriculture decreases with technological development and modernization, the target population of agricultural extension and community development programmes in food production becomes smaller, more educated, and in control of a larger proportion of community assets. Vegetable gardens and poultry programmes become irrelevant as farm dwellers move into cities and have to buy their food in the markets. That the green revolution might make the rich richer and the poor poorer (4), points out the fact that while popular participation in food production increases the quantity of food available for consumption, it does not necessarily provide food for the increasing number of those who become totally dependent on the market but marginal to the production process. It is only through the recent land reform programmes that opportunities for the participation of a larger number of people in agricultural food production have been opened up. As a result of land reform, standards of living have improved not only because of an increase in agricultural products, but also because of a redistribution of income. At the same time, land reform has created possibilities for participation in community decision-making processes, since the decision of a new group of small holders can also affect the level of production in the community as a whole (5). Even within the context of land reform, however, when the criteria established for distribution of land excludes certain categories of the rural population, such as seasonal labourers formerly engaged in agricultural activities, the effect of redistribution of income would have an adverse effect on these groups in the absence of employment opportunities outside agriculture. The small owner cannot afford to hire seasonal labour (6).

It is in this context that food becomes a component of a wide range of social norms and values usually defined in terms of social justice, or how the society should organize itself to respond to the human rights of its members.

Food distribution

A discussion of the social problems involved in the distribution of food among the members of society, as a matter of human rights rather than an economic privilege, is beyond the scope of this paper. It is sufficient to point out that the level of income determines, to a large extent, the quantity of food obtained for consumption. Thus, policies of social insurance, minimum wages, subsidies, social services including welfare and redistribution of means of production such as private property in agriculture, which promote a fair distribution of income, necessarily affect food consumption. In this context, the clientele of food programmes constitutes a variety of groups which include the aged, the unemployed, the handicapped and other groups which depend upon social welfare for food. Popular participation and community involvement in distribution of food programmes as a component of social justice has taken the following forms:

a) Mass movements to bring about structural changes in the society, creating new channels and processes for food distribution and trying to alleviate hunger as well as other forms of deprivation. These movements, crossing the geographical boundaries of communities in pursuit of common aims, have been able to affect societal decisions by employing tactics such as organized pressure group actions, demonstrations of political power, civil disobedience and strikes. The history of land reform in many countries of Asia, Africa and Latin America (5) and the recent civil rights activities in the United States are examples of these movements. However, since the objectives of most of these movements are to remove the institutional barriers (class differences, economic exploitation and different forms of structural exclusion from the life of society in general) that impede the exercise of social justice, the institutionalization of these pressures constitutes the major task of these movements. The creation of specific pressure groups, such as consumer cooperatives and unions or "watch-dog" groups concerned with the quality and quantity of food offered in the market, is a component of the institutionalization of consumer pressures for food improvement. Depending upon what is perceived by these groups as the cause of hunger, their activities may include exercising pressure for adoption of government policies to provide incentives for private enterprise to make high-quality and reasonably-priced food available for all, including the poor, or to establish public price and control mechanisms in order to influence the food market to the benefit of the poor. There are no statistical data accurately showing the difference in food intake of the poor before and after such movements, but judging from the results of land reform programmes (a partial attempt at distribution of income), it would be safe to assume that, as one form of participation in influencing societal decisions, these movements help to remove the disparities in food consumption between those who have more than they can consume and those who have not.

b) Most of the prevailing food distribution programmes require local organization, distribution facilities and self-help activities in which popular participation and community involvement are essential elements. Since these programmes are designed to help the vulnerable people such as the aged, the children and the handicapped, other active groups participate on their behalf. The participation required in these distribution programmes, however, is a passive one; it is not likely to affect societal decisions on the quantity of food, the price of food, the location of its distribution or the type of food distributed. On the other hand, lack of participation would mean a loss of the food offered as a result of welfare policies or humanitarian activities - policies and activities aimed at rectifying the malfunctioning of the existing economic, social and political systems in terms of the objectives of social justice.

One of the major programmes of this nature is the school lunch for children, which has now gained world-wide attention and recognition. Other programmes, as developed in the United States, include Commodity Distribution for Needy Families, Food Stamps, Consumer Education, and Public Assistance Programmes. A study of these programmes, however, indicates that even when food is distributed freely among the clientele, there are inherent barriers to full participation. Some of these barriers are inability of the poor to pay for the expenses accompanying free food, the criteria established for eligibility for participation, excluding those who are in most need, and the stigma attached to lining up as poor and hungry in order to receive free food. In Tanzania, for example, children were not participating in school lunch programmes because the parents had to pay six shillings a year as a contribution towards the transportation cost (7). In the United States, participation in the Commodity Distribution Programme was hampered because the depots were too distant and incurred transportation costs, and the commodities as packaged were difficult to carry (8). It is only when the food distribution programmes are formulated outside the welfare systems, with built-in components of social development, that participation and community involvement occur on a larger scale. In these programmes, food distribution promotes activities not only in relation to the alleviation of present hunger, but also in relation to the future social and economic needs of the poor. An outstanding example of this type of programme is the World Food Programme, designed to promote community development through establishment of self-help projects, nutrition education, vocational training and establishment of social institutions which provide channels for participation of people in their own community affairs. Recent attempts by some minority groups in the United States to provide breakfast to needy children outside the official welfare channels also indicate that, by mobilizing the resources of the community, the needs of children can be met with much more efficiency than through the normal channels. Since these are isolated programmes organized on a small scale, the potentiality of their bringing about basic changes in the food distribution system of the society is very limited; they serve mainly to broaden the consciousness of the community with regard to their food problems and, as such, their objectives may expand into other social problems besides food.

Improvement of food consumption

Assuming that the society can make satisfactory arrangements to eliminate the inequalities in food distribution among socioeconomic groups, the problem of the quality of food is a matter of ecological conditions and cultural factors which determine the food habits in a community, with the income factor playing a smaller role.

The importance of the sociocultural and psychological aspects of food habits have been emphasized in several studies (9).

It has been recognized that the division of labour in the family and community, social status, age, sex, and conditions of pregnancy and illness are major determinants of food habits, which might result in adequate distribution of food within the family or the community. The ceremonial role of food, its relationship to religion, magic and the supernatural, and its function as a link between members of a group, are also some important factors that influence attitudes towards food, including food fads and food taboos. Food preferences are not only functions of a long period of socialization of individuals, but are also present at a very early age, reflecting the community norms and values concerning food.

A draft report by WHO on human testing of protein-rich food concludes that, among the subjects tested (ages 1.3 months to 5 years) in several countries, when the product tested contained ingredients familiar to the community and used by it, it was invariably found to be well-accepted and tolerated. The study further points out that a protein-rich food mixture must be accepted not only by the children for whom it is intended, but also by their mothers, who will decide for or against its use, and by the community as a whole (10). Thus, popular participation and community involvement in improving the quality of food involves decisions which tend to affect the cultural values and social functions of food and thereby determine the behaviour of individuals in its procurement, preparation and consumption.

For any type of social management, there are two basic methods of changing the level of behaviour. One is by adding forces in the desired direction, and the other by diminishing opposing forces. The forces (norms, values and standards) which affect the process of food consumption operate within the two channels by which the food is brought to the table; one is the buying channel and the other the gardening or subsistence farming channel. Studies in food habits outside the subsistence channel indicate that housewives are the major decision-makers as to the type and composition of the food prepared for the table. In one of the experiments conducted for the purpose of changing food habits in the United States (11) it was found that when housewives participated in a group discussion in which the consumption of a new item (meat) was discussed in terms of a wider context (war effort), explaining its additional values for health and working ability with the aid of audio-visual material, the change of food habit came to represent the interests of the group. As a result, each individual incorporated it in her discussions in private life. Thirty-two percent of the participants changed their food habits following the discussions, and this percentage rose considerably during the following weeks. The participating educational process embodied in these group discussions made it possible for the group to acquire a new standard and thereby motivate a change of habit of individual members, reducing the social and psychological resistance to this change.

Once a high protein product is available for consumption, it should be as thoroughly integrated into the prevailing cultural values of the community as possible, by appealing to groups or individuals who have certain health beliefs and whose decisions influence the food habits of the community. Since in most cases protein-rich food is purchased at the market, ways should be provided for people themselves to have an opportunity to manipulate their own cultural behaviour in order to gain acceptance for, and perhaps make a social or economic profit from, the high protein food that is being developed commercially.

A study of the East Indian villagers on the Corentyne coast in Guyana (12) points out that once the value of food was understood by the people and there was a possibility that they could profit from the sale of the products as well, a change of food habits was not a problem. The following suggestions, which might be applicable to many developing countries, emerged from this study:

1) The food could be made culturally acceptable by having it blessed by individuals

holding positions of moral authority in the community.

2) Taste and packaging are secondary considerations, and not very important, once religious cultural approval is established.

3) Women could be taught directly how to prepare the food in the special cooking shed which is part of the religious compound and complex. This is where devotees congregate periodically. The food would also be eaten in the compound.

4) Special attention should be paid by the community leader to selected cases of malnutrition in order to provide a demonstration effect.

5) Cooperating members of the religious institution could also possess a business "share" of the food product. They would make home visits and visits to the "demonstration" cases to insure daily use.

6) Purchase of the product would initially be restricted to the religious compound. Later, distribution and marketing would be attempted through investment in a second-hand vehicle equipped with loudspeakers which would penetrate the more remote village areas.

7) A certain amount of the food would have to be distributed free to those unable to buy it.

8) Consideration would be given later to supplying the product to the usual shop outlets. The objection to these sources as outlets during the early phases was that the shopkeeper would tend to raise the price and might reserve the product for the better-off, rather than the poor.

9) Those members of the community working full time in the marketing and distribution aspects of the programme should eventually receive the equivalent of their present weekly salary elsewhere in the community. With the success of the programme, a method of profit-sharing among community shareholders would have to be worked out.

Conclusion

The true measure of the success of food improvement programmes is the degree to which they are accepted by their target population. There is a vast amount of accumulated evidence that a community's social and cultural characteristics are the major determinants in such acceptance. Popular participation and community involvement is an effective strategy that can relate the formulation and implementation of food improvement programmes to the characteristics of the target population and can be applied to food production, distribution and consumption.

The effectiveness of this strategy in food production has long been tested successfully through agricultural extension and community development programmes. However, as the production of food becomes more technology and capital intensive and thereby more specialized, involving a fewer number of producers, the social aspects of food distribution and consumption assume more vital importance for the success of these programmes.

The problem of food distribution cannot be isolated from the overall problem of equitable distribution of income and wealth in the nation, the solution of which requires institutional reforms. There have been only a few experiments in this field. When the political structure of a society provides channels for popular participation to bring about these reforms, the problems of food distribution will be solved in terms of the enhancement of social justice. In the absence of institutional reforms, popular participation and community involvement can help the stop-gap measures of welfare food distribution programmes to become more effective in reaching small selected groups among the vulnerable segment of the population.

Community development programmes have proven that through popular participation and community involvement, problems of food habits and food preferences can be overcome successfully, provided that the individual and the community can afford, economically and socially, the change in food consumption habits; i.e., when the forces behind the rationality of new habits become stronger than those maintaining the old ones. Many studies in developing as well as in developed countries indicate that the resistance attributed to the psychological and cultural factors is usually a function of the price of the food.

Since those in need of food, the poor, are farthest removed from decisions affecting food price, their participation can take two consecutive forms: a)community action creating pressures for government intervention in providing food free or at just prices, and b) organizing for distribution of food at the community level through cooperatives run by community members. These cooperatives can then mobilize other community resources, physical as well as human, to develop the community's own decision-making structure for economic, political and social activities.

When the forces operating against a change of food habits are generated purely from cultural factors such as religion, superstition, unfamiliarity and adverse psychological reactions, the resistance could be overcome by a participatory educational process. In this the leaders of the community and those whose decisions are most vital to the preparation of food, such as housewives: a) become aware of the position of food in the wider context of health, ability to work and other values that are respected by the community, b) organize collective action and pressure groups for the purpose of improving the quality and quantity of food, controlling prices and ensuring availability, and c) institutionalize these collective actions so that they become part of the community's structure and grow as the food problem increases in complexity inthe process of development. The participatory educational process referred to above is a process where the agent of education, community development worker, agriculture extension worker, home economist or any other representative of the national programme located at the grass-roots level, establishes a two-way communication between himself or herself and the clientele of the programme, as a result of which both parties increase their knowledge of the food problems in the community. Personal contact between the educator and the individual members of interested groups in the community, preferable at community centres, has proven to be the most effective method of establishing a participatory educational process. The use of audio-visual methods would also increase the efficiency of the teaching process.

References

1. Concepts and definitions based on Etzioni, A. 1968. The active society. Collier-Macmillan, London, England. pp. 98, 249-272, 384, 410-554.

2. Niehoff, A.H. (Ed.). 1966. Casebook of social change. Aldine Publishing, Chicago, Ill., U.S.A. pp. 201-206.

3. Based on documents pertaining to Cooperatives and Village Councils in Camilla Project, East Pakistan.

4. United Nations Administrative Committee on Coordination. 1970. CO-ORDINATION/R. 838. 28 Sept. Restricted distribution; paras. 33-38.

5. UN/FAO/ILO. 1970. Progress in land reform. Fifth Report, pp. 227-248.

6. Observations on land distribution in Iran; discussion with Plan Organization officials.

7. Hopcraft, A. 1968. Born to hunger. Pan Books, London, England. p. 14.

8. Anon. 1968. Hunger, U.S.A. A report by the Citizen's Board of Enquiry into Hunger and Malnutrition in the United States, New Community Press, Washington, D.C., U.S.A. pp. 50-56.

9. For example:

   a) Carine, I. 1970. The social and cultural background of food habits in developing countries. FAO Nutrition Newsletter 8, No. 1:9-21.

b) Anon. 1945. Manual for the study of food habits. Bulletin of the National Research Council No. III, January. pp. 31-48.

10. WHO. 1970. Consultation on human testing of protein-rich food. World Health Organization, Geneva, Switzerland. p. 9.

11. Lewin, K. 1947. Group decisions and social change. In Reading in social psychology (Newcomb and Hartley, Eds). Henry Holt, New York, N. Y., U. S. A. pp. 331-344.

12. Singer, P. 1968. The importance of anthropological factors in determining the cultural practices, with special attention to marketing. Presented before the American Public Health Association, Inc., Food and Nutrition Section, Detroit, Mich., U. S. A., Nov. 13. pp. 14-16. Mimeographed.

UNDERWATER AND UNDERGROUND HERMETIC STORAGE OF CEREAL GRAINS PACKAGED WITH CEM - SKIN PACKAGING PROCESS

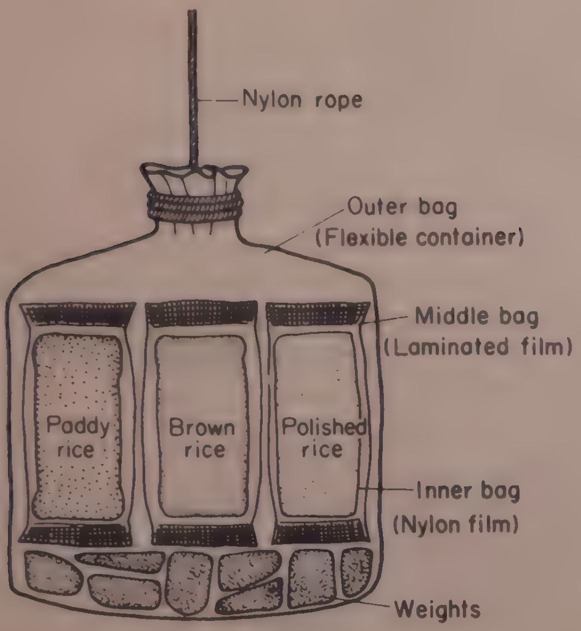
by Hisateru Mitsuda, Fumio Kawai and Aijiro Yamamoto, Department of Food Science and Technology, Faculty of Agriculture, Kyoto University, Kyoto, Japan

A major source of proteins and calories for human nutrition are the cereals. The world food balance and future projections have indicated that cereals play a central role in alleviating the world food problem we are confronted with today. Although there is no single approach to the world food problem, the most feasible solutions are augmentation of cereal production and reduction of loss or waste during transit and storage.

The purpose of this study is to develop a novel method of storing the cereals for long periods without substantial loss of quality. A large-scale experiment has been carried out for storing cereals underwater or underground. Some features of this method are reported briefly elsewhere (1). Thus, only results obtained throughout the experiment are presented here.

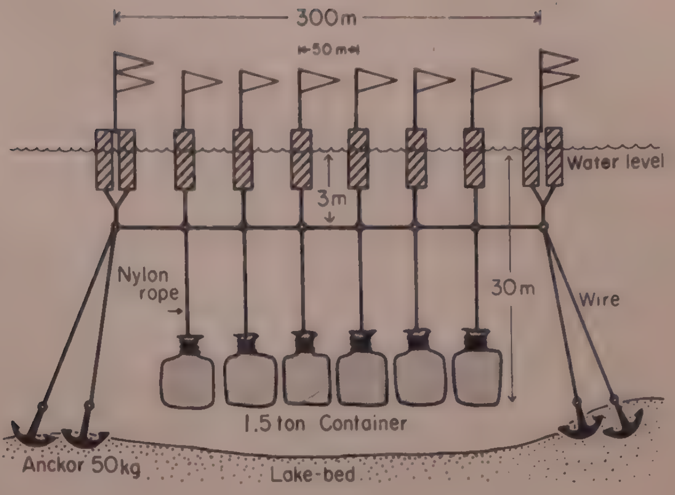
Figure 1 shows the packaging system. The bags of grains (rice or wheat) or seeds (soybean) weighing 60kg were double packed with inner and middle bags and sealed in an air or CO_2 atmosphere. These bags were then packed together in the outer bag with some weights. Although these packaging materials function individually, the middle bag, made of film laminated with oriented nylon film, polyvinylidene chloride film or aluminum foil and polyethylene film is the most important. Figure 2 is a sketch of the experimental system adopted in underwater experiments. Changes in the quality of the cereals during storage are followed over a year by estimation of moisture content, chemical composition, biological activity and palatability factors. The quality changes observed in underwater or underground storage are found to be less than those stored under atmospheric conditions and within the range found in storage in temperature-controlled warehouses. The costs for construction and maintenance of this novel storage system on a 10-thousand-ton scale are calculated to be less than 30 dollars per ton of cereal and appear fairly low compared with those

FIGURE 1


Nylon rope
Outer bag
(Flexible container)
Middle bag
(Laminated film)
Paddy rice
Brown rice
Polished rice
Inner bag
(Nylon film)
Weights

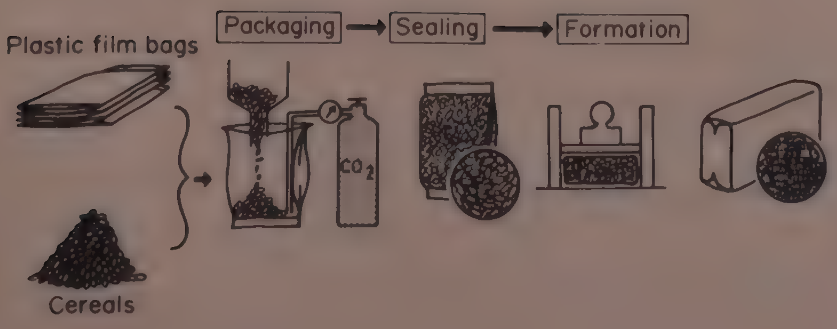
Packaging Materials for Underwater Experiment of Cereal Storage

FIGURE 2


300m
50m
Water level
3m
Nylon rope
30m
Wire
1.5 ton Container
Anckor 50kg
Lake-bed

A Sketch of Experimental System
- Underwater Storage of Cereals -

FIGURE 3


Packaging
Sealing
Formation
Plastic film bags
CO2
Cereals

Schematic Diagram of CEM- Skin Packaging Process
CEM: Carbon dioxide Exchange Method

needed for the temperature- and humidity-controlled storage system.

During the laboratory-scale storage experiments, which have been conducted since May 1967, cereal grains in plastic laminated film bags containing CO_2 gas are found to be as tightly packed as if packed in a vacuum. The decrease in head-space volume in the bag is due to adsorption of CO_2 gas by the grain. Wheat, barley, corn, sesame, soybean, red bean, coffee bean and other cereals besides rice, are found to have this property in the form of either grains or flours. The adsorption process is reversible and the adsorption amount differs according to the kinds of cereals employed.

These phenomena were followed by the development of a useful technique of cereal skin packaging, called Carbon dioxide Exchange Method- (CEM-) skin packaging. Figure 3 is a schematic diagram of the CEM-skin packaging process. In this process, cereals are first packaged with an appropriate volume of CO_2 gas in a bag made of plastic film of low gas permeability and then sealed. At this stage, CO_2 gas surrounds the cereals and expands the bag. The bag, however, gradually decreases in volume due to the CO_2 adsorption by the cereals. The shape is formed before complete tightness is obtained if it is desirable. In packages obtained this way, CO_2 gas is apparently adsorbed on the surface of a porous structure in the cereal grains. Skin packaging of materials which are not capable of adsorbing enough headspace CO_2 is also achieved by using a film with a slightly higher gas permeability. The permeability of plastic films to CO_2 is usually higher than to N_2 and O_2. Higher fugacity of CO_2 from the bag and poor permeability of atmospheric gases into the bag results in a negative pressure within the bag. Materials of non-biological origin in the form of tips, beads and powders can also be tightly packed by this technique. The technique is expected to displace the usual vacuum- or shrink-packaging techniques. It is applicable to almost all solid materials. Skin packaging of wheat flour, for example, is readily achieved by CEM without high-vacuum and high-temperature treatments.

Packages obtained by this technique contain inert gas and thus preservation of quality, as observed in the underwater experiment, and protection against aerobic microbial infection are effected. The technique is also effective in reducing storage space in addition to diminishing the quality changes of stored cereals. The production cost of the packages is below 5% of total product cost.

CEM-skin packaging techniques were reported in more detail at the 31st Annual Meeting of the Institute of Food Technologists in New York, May 23-27, 1971.

The development of methods to utilize cereal proteins more effectively for human nutrition is an important problem. These novel techniques of cereal storage and packaging are expected to contribute to the development of work concerned with the problems of protein in the world.

Reference

1. Mitsuda, H. 1969. Grain storage can be a cover up. Food Tech. 23:64.

HIGH - LEVEL UNITED NATIONS PANEL TO WORK OUT STRATEGY FOR COMBATTING PROTEIN DEFICIENCY

A special high-level United Nations panel to work out a programme of concerted international action to avert the world protein crisis met on 3-7 May 1971 at United Nations Headquarters, New York.

A United Nations report*, issued in 1967, found that over 300 million children suffered grossly retarded physical growth and mental development for lack of protein and calories. Guidelines were then recommended for action to tackle the problem, including proposals for a United Nations Protein Fund and for focusing attention on improving protein consumption.

The panel meeting considered what measures will be required at the national and international level to implement more effectively the 1967 guidelines as well as proposals made in subsequent reports, including a call for the establishment of a world protein policy body.

Participating in the meeting were scientists, economists and bankers of world repute; others were Cabinet Ministers and representatives of interested United Nations bodies and international scientific organizations. A number of background papers were presented.

The Secretary-General's Report on the meeting is available from the United Nations as document E/5018. It contains a policy statement suggesting the role of Governments and the contribution of the United Nations family in a concerted worldwide attack on protein deficiency, especially in Third World countries where the problem is most acute.

Organizational arrangements required to give effect to these suggestions, including what financial resources would be needed and how these resources could be raised, were recommended.

The panel was convened in response to a request** made last year by the United Nations General Assembly in which the Assembly expressed concern at the lack of a coherent plan of international action in the field of protein and asked the Secretary-General to prepare such a plan with the help of independent experts.

Members of the Panel

Norman E. Borlaug (U. S. A.)
Sumitro Djojohadikusumo (Indonesia)
David Hopper (Canada)
Goran Ohlin (Sweden)
Fred T. Sai (Ghana)
Jacques Senez (France)
C. Subramaniam (India) - Chairman

Representatives of the United Nations Family

UN and UNDP:

Philippe de Seynes, Under-Secretary for Economic and Social Affairs.

Paul G. Hoffman, Administrator of UNDP.

G. B. Gresford, Director for Science and Technology.

B. Barg, Chief, New Technologies Section, Office for Science and Technology.

Morris A. Huberman, Chief, Agricultural Production Programme of UNDP.

Alexander Keynan (ACAST).

Carroll L. Wilson (ACAST).

FAO:

Oris V. Wells, Deputy Director-General.

M. Autret, Director, Nutrition Division.

Donald W. Woodward, Director, FAO Liaison Office in N. Y.

IBRD:

Harold H. Graves, Associate Director, Development Services Department.

---

* Document E/4343/Rev. 1.

**General Assembly resolution 2684 (XXV) of 11 December 1970.

S. Takahashi, Agriculture Projects Department.

John Maddox, Information and Public Affairs Department.

Unesco:

Adriano Buzzati-Traverso, Assistant Director-General for Science.

Anton Burgers, Programme Specialist, Division of International Co-operation in Scientific Research, Department of Science Policy and Promotion of Basic Sciences.

UNICEF:

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L.J. Teply, Senior Nutritionist.

M. Milner, Senior Food Technologist.

WHO:

R.L. Coigney, Director, Liaison Office with United Nations.

E.M. DeMaeyer, Medical Officer, Nutrition Unit.

IAEA:

André Finkelstein, Deputy Director-General, Department of Research and Isotopes.

Bjorn Sigurbjornssen, Deputy Director of the Joint FAO/IAEA Division.

UNIDO:

Aron J. Aizenstat, Director, UNIDO Liaison Office, N.Y.

PAG:

Nevin S. Scrimshaw, Chairman

G.D. Kapsiotis, Acting Secretary

Observers from International Scientific Bodies

International Council of Scientific Unions (ICSU); International Union of Nutritional Sciences (IUNS)

Charles Glen King

International Union of Food Science and Technology (IUFoST)

Mogens Jul

Kampala, Uganda

REPORT ON THE UNICEF/FAO - SPONSORED SEMINAR ON THE PRODUCTION, UTILIZATION AND MARKETING OF SOYBEANS

The seminar, held from 16 to 19 February 1971, was attended by delegations from Ethiopia, Kenya, Uganda and Madagascar. Each delegation presented a statement on the status of soybeans. Representatives from Tanzania, Zambia and Malawi were invited but did not attend.

The seminar emphasized three aspects of soybeans in Eastern Africa, namely agricultural production, utilization including processing, food formulation and quality control, and marketing of soybeans and soybean products.

The problems of introducing any new crop into the agricultural pattern in a developing country were explored. Soybeans have had a history of modest but significant production in Tanzania and Uganda, but nonetheless, much effort in breeding and selection is still needed to find improved varieties suitable for the varying altitude and agronomic conditions in this region. The experience of recent successful introduction of soybeans in India was reported. Plant quarantine regulations in East Africa, which limit introduction of new breeding stock, are an obstacle to intensified soybean research but they are a means of avoiding the introduction of seed-borne diseases.

Seminar participants paid a visit to the small plant of Africa Basic Foods at Kampala, whose major problem at this time is procurement of good quality soybeans. Newer products of Africa Basic Foods were described and tasted; they included a soynut butter and deep-fried soybean snacks. The simple methods of production used in this factory were studied and contrasted with current technology in the United States as presented in a paper by the Director of the Northern Regional Laboratory of the Agricultural Research Division, U. S. Department of Agriculture. Further information on the history and development of soybean production and processing in the United States was well presented through a special film.

On the topic of soybean processing and utilization, papers and discussions focused on topics of quality and process control and on food uses in programmes to combat malnutrition, particularly in infants. The WHO procedures for clinically-supervised testing of soy-based high protein foods with infants were described with respect to an FAO/WHO/UNICEF project in Madagascar. Prospects for industrial and village-scale processing of soybeans were explored.

The marketing of soybeans, soybean oil and meal was surveyed with respect to both domestic and export needs and opportunities. Market prospects seem to be favourable for soybeans within Eastern Africa, although even here the difficulties and costs of transport to market pose obstacles. Since available cottonseed processing facilities are inefficient, better oil recovery plants could be erected only if significant production of soybeans appears. It was clear that the major utilization would be as vegetable oil products and protein concentrates for animal feeding. The guidelines for formulation and marketing of protein weaning foods as used by United Nations Agencies in joint projects were reviewed. A manual on the marketing of protein foods under publication by the PAG was discussed, and experience from FAO/WHO/UNICEF projects in various countries was reported. Additionally, some marketing problems related to the development of a weaning food in Ethiopia were presented.

The importance of involving commercial firms in production and marketing of protein foods was stressed, and it was noted with regret that very few of the companies invited had sent representatives to the seminar.

An ad hoc Committee was formed from among the representatives of the four countries participating to determine the impact of the seminar on Governments and to look into ways to further its recommendations. It is hoped that the Governments of Tanzania, Zambia and Malawi will send observers or representatives to the first meeting of this Committee, which is planned to be held within the next six months. The UNICEF East Africa Regional Office will undertake wide dissemination of the conclusions and recommendations from the seminar as well as of the papers presented, and will cooperate with the efforts of the Committee.

KOH

Beirut, Lebanon

SIXTH SYMPOSIUM ON NUTRITION AND HEALTH IN THE NEAR EAST

This annual regional scientific meeting was held at the American University of Beirut from 26 to 29 April 1971 and was attended by more than 100 workers from 15 countries. The four-day meeting was sponsored by the Graduate Nutrition Program of the University with assistance from UNICEF.

Two major topics of considerable practical importance were discussed from medical, food and agricultural, social - economic, educational and planning points of view by different speakers. These were "The Causes of Childhood Malnutrition" and "The Combat of Childhood Malnutrition". The general consensus was that in this region the causes of protein-calorie malnutrition are multiple and that poor living conditions, overcrowding and poverty play a larger part than purely dietary factors. It was recognized that many of the efforts being taken to combat the problem were having little success, either because they approached it from only one angle or because they failed to strike at the root causes.

The need for planning an integrated approach was stressed. Helpful discussions were held on "The Teaching of Nutrition in Schools of Agriculture and Medicine".

One day was given to original research communications and almost thirty of these were presented from many countries of the region, indicating a great growth of interest in nutrition in this area in recent years.

The proceedings of the symposium will be published shortly. Anyone interested in receiving fuller information should write to Dr. D. S. McLaren, School of Medicine, American University of Beirut, Lebanon.

DSM

M. G. Tan et al:

SOCIAL AND CULTURAL ASPECTS OF FOOD PATTERNS AND FOOD HABITS IN FIVE RURAL AREAS IN INDONESIA

A report of the National Institute of Economics and Social Research (LEKNAS) of the Indonesian Institute of Science (LIPI) and the Directorate of Nutrition, Department of Health, Djakarta. The survey was conducted in the latter part of 1969 and the report issued in 1970.

The results contained in the report are based on a study of the social, cultural and psychological factors related to food patterns and food habits in a representative group of population in five different provinces of Indonesia. The report describes in detail the selection of the area, the social and cultural characteristics of the population, their food patterns and food habits with special reference to foodstuffs grown locally, meal pattern, diet for infants and children, beliefs and taboos. The findings of the survey are described in great detail and the information will be useful for those engaged in implementation of nutrition programmes in the country.

The study was carried out specifically in connection with the Indonesian Government's Applied Nutrition Programme, which is supported by FAO, WHO and UNICEF.

Tan, Mely G., et al. 1970. Social and cultural aspects of food patterns and food habits in five rural areas in Indonesia. National Institute of Economic and Social Research, Indonesian Institute of Science and Directorate of Nutrition, Department of Health, Djakarta, Republic of Indonesia. 131 pp. Mimeographed.

NEW ZEALAND WHOLEMILK BISCUIT

- The wholemilk biscuit is a dairy food aid developed in New Zealand. The biscuit, an exclusively wholemilk product, is available under New Zealand's commodity pledge and thus forms part of the resources of the World Food Programme.

The biscuit was developed in New Zealand specifically as a means of making milk protein easily available in areas beyond the limits of fluid milk distribution, or even of certain traditional dairy products, at minimum cost over that of the basic raw materials. Under the aegis and with the assistance of the WFP, the biscuit was tested under a variety of conditions in different regions of the world. These tests, together with others conducted under New Zealand bilateral and private aid programmes, have given satisfactory results.

Since the biscuit's acceptability and value as an instrument of dairy food aid is now established, the New Zealand Dairy Board which, in collaboration with New Zealand scientists, developed the biscuit, has agreed to disclose all information relevant to the composition, production and manufacture of the biscuit. The New Zealand Dairy Board will make these details available on request to any government, official or private institution or other organization which may wish to utilize the biscuit for noncommercial purposes. For such purposes, royalty rights and other exclusive proprietary qualifications or conditions will be waived.

To ensure that the biscuit is not utilized for purposes other than those for which the World Food Programme was designed, New Zealand would not wish to see introduced commercial competitive considerations such as brand marketing and patenting of marginal variations. The biscuit should not be produced for sale in overseas markets as a means of securing a commercial return on subsidized production surpluses.

A daily allowance of two of the New Zealand-produced biscuits, which are fortified with vitamins and minerals, provides for children in the younger age groups approximately 36 per cent of the recommended protein intake and 50 per cent of the recommended daily calorie intake.

The approximate cost of the biscuit, based on current prices for wholemilk ingredients, labour and other costs is within the range of US $550 - 600 fob per ton; about 1.3 cents per biscuit or about 8 cents per litre of wholemilk equivalent. The capital cost of a plant for manufacture of the biscuit from basic dairy products capable of producing some 20,000 biscuits per 8-hour shift is at present about US $42,000. For manufacture of the biscuit from a granulated premix the plant cost is about $9,000. Small milk biscuit manufacturing units of this type utilizing granulated milk biscuit formulations which can be supplied from New Zealand would, for a small capital outlay, enable children to be supplied with a one-sixth litre milk equivalent, in a form which has been shown to be completely acceptable and to eliminate virtually all waste, for a little more than the cost of normal wholemilk powder.

The step New Zealand is taking should apply to the following situations:

1) It will enable the authorities of a developing country interested in using a mix of imported and/or local milk for their own food protein needs to do so by establishing a wholemilk biscuit plant.

2) It will permit the establishment of biscuit manufacturing operations in developing countries using a granulated premix supplied from overseas.

3) It will enable the authorities of a developed country considering the conversion of surplus milk into the wholemilk biscuit for use in internal or overseas food programmes to do so.

The WFP will also be happy to render such help as may be necessary both in supplying details of the results of field tests carried out with the biscuit and as a channel of communication with the New Zealand Government and Dairy Board.

NEW INTERNATIONAL INITIATIVE TO STRENGTHEN AGRICULTURAL RESEARCH FOR BENEFIT OF DEVELOPING COUNTRIES

The Council of the Food and Agriculture Organization of the United Nations (FAO) has expressed strong support for a new international research initiative to help developing countries increase and improve the quality of their agricultural output and thus raise standards of living.

A new Consultative Group on International Agricultural Research sponsored by FAO, the World Bank and the United Nations Development Programme (UNDP) has been formed. The Group, in which eight governments, four international and regional development organizations, three private foundations and the International Development Research Centre (IDRC) are participating, held its inaugural meeting in Washington, D.C., U.S.A. on 19 May 1971.

Although the Group will be based in Washington, a Technical Advisory Committee of twelve distinguished scientists with wide experience in the agricultural problems of developing countries will be served by a secretariat provided by the FAO in Rome.

Recalling the great success of agricultural research in producing high-yielding varieties of wheat, maize and rice, a report of the Council noted, however, that there "are significant gaps in the coverage of research", both geographically and in subject matter. "To maintain technical progress and to achieve new breakthroughs, to overcome socioeconomic obstacles to their adoption by farmers and to avoid pitfalls of environmental pollution", the report said, "requires a major interdisciplinary research effort which is often beyond the resources of individual developing countries".

On the basis of current pledges, the Consultative Group will have about $15 million annually to finance selected agricultural research projects for the benefit of developing countries.

Members of the Group, in addition to the three co-sponsors, are: Canada, Denmark, France, the Federal Republic of Germany, Netherlands, Sweden, United Kingdom and the United States; the African Development Bank; the IDRC; and the Ford, Kellogg and Rockefeller Foundations.

It is expected that additional countries and organizations will join the Group as members. The FAO Conference convening in November will be asked to nominate five developing countries, representing each region, for membership.

The Technical Advisory Committee, headed by Sir John Crawford, an economist and Vice-Chancellor of the Australian National University, is to hold its first meeting in Rome toward the end of June.

THE INTERNATIONAL COMMITTEE FOR THE ANTHROPOLOGY OF FOOD AND FOOD HABITS

As a result of the Sixth International Congress of Anthropological and Ethnological Sciences held in Paris, Working Group 10 (Ritual Foods and Beverages), it was decided to form a Committee for the Anthropology of Food and Food Habits. The field of food habits is at the crossroads of various disciplines with the result that information relating to it is scattered throughout the anthropological and other literature. Anthropologists seldom specialize in this area of research.

The Committee would like to provide a link between the various scholars who have been concerned with food habits and nutrition at large, as well as those who are studying the cultural factors underlying food production, distribution, storage, processing and consumption. The subject is fundamental to both pure and applied social science.

The Committee plans to compile a directory of anthropologists and other specialists working in this field, according to their particular subject and geographical area of interest, in order to facilitate the exchange of information. A journal for the publication of bibliography, abstracts, research papers, and relevant communications is in the process of being established. A small documentation centre has already been created from which a clearinghouse will be evolved, and where food habits data may be stored to be at the disposal of Committee members and interested researchers. Any scholar with an interest in food and its uses in human culture, who might be interested in discussing the possibility of beginning a journal devoted to food habits, please contact:

Mr. Robert L. Freedman
1603 Dole Street, Apt. 301
Honolulu, Hawaii 96822, U.S.A.

CFTRI ABSTRACTS

The Director of the Central Food Technology Research Institute, Mysore, India, has informed the PAG that the Institute will be able to supply free of charge copies of CFTRI abstracts for the use of individual research workers or institutions. Please address inquiries to:

Director
Central Food Technology Research Institute
Mysore-2, India

RECENT PUBLICATIONS

AOAC. 1970. Official methods of analysis of the Association of Official Analytical Chemists. 11th edition. AOAC, Washington, D. C., U. S. A. USA $30.00; other $31.00.

Aykroyd, W. R., and J. Doughty. 1970. Wheat in human nutrition. Nutritional Studies No. 23. Food and Agriculture Organization of the United Nations, Rome, Italy. 163 pp. $3.50.

Bender, A. E. 1967. Dietetic foods. Chemical Publishing Co., New York, N. Y., U. S. A. 286 pp. $13.50.

Commonwealth Bureau of Animal Nutrition. 1968. Fungi and unicellular algae as foods. Annotated Bibliography No. 6. CBAN, Aberdeen, Scotland. 44 pp. + 15 pp. supplement (1968-70). $4.92 (41 shillings).

Dalrymple, D. G. 1971. Imports and plantings of high-yielding varieties of wheat and rice in the less developed nations. Foreign Economic Development Report No. 8. Foreign Economic Development Service, USDA in cooperation with US/AID, Washington, D. C., U. S. A. 43 pp.

FAO. 1970. Review of food consumption surveys. Vol. 1A - Household food consumption by economic groups. Food and Agriculture Organization of the United Nations, Rome, Italy. 139 pp.

FAO. 1971. Technology of the production of cottonseed flour for use in protein foods (M. C. Verdery, consultant). Agricultural Services Bulletin No. 7. Food and Agriculture Organization of the United Nations, Rome, Italy. 42 pp.

Fisher, P., and A. E. Bender. 1970. The value of food. Oxford University Press, London, England. 174 pp., paperback. $2.50.

Gray, W. D. 1970. The use of fungi as food and in food processing. CRC Press, Cleveland, Ohio, U. S. A. 113 pp. $12.75.

Harvey, D. 1970. Tables of the amino acids in foods and feedingstuffs. Technical Communication No. 19, 2nd. ed. Commonwealth Bureau of Animal Nutrition, Aberdeen, Scotland. 105 pp. $4.80 (40 shillings).

Nestlé Foundation. 1970. Annual report. Lausanne, Switzerland. 19 pp.

The Rockefeller Foundation. 1970. President's review and annual report. New York, N. Y., U. S. A. 229 pp.

UNIDO. 1971. Manufacture of chemicals by fermentation. Report and proceedings of the Expert Group Meeting held in Vienna, 1-5 December 1969. United Nations Industrial Development Organization, Vienna, Austria. 46 pp. $0.75.

PAG STATEMENTS AND GUIDELINES AVAILABLE

PAG Statements

No.	Title	Date
2	PAG Recommendation on aflatoxin	1969
3	PAG Statement on the nature and magnitude of the protein problem	1971

PAG Guidelines

2	PAG Guideline for preparing food-quality groundnut flour	1970
4	PAG Guideline for preparation of edible cottonseed protein concentrate	1970

4	PAG Statement on single cell protein	1970
5	PAG Statement on the marketing and distribution of protein-rich foods	1971
6	PAG Statement on milk substitutes	1970
7	PAG Recommendation on prevention of food losses and protein-calorie malnutrition	1969
8	PAG Statement on plant improvement by genetic means	1970
9	PAG Recommendation on amino acid fortification of foods	1970
10	PAG Statement on a systems approach to the formulation and evaluation of nutrition intervention programmes	1970
11	PAG Statement on leaf protein concentrate	1970
12	PAG Statement on the world protein problem: research and development needs	1971
13a	Review of the specific proposals contained in ACAST report "International Action to Avert the Impending Protein Crisis" United Nations, 1968	1971
14	PAG Statement on marketing of conventional foods	1971

5	PA G Guideline for edible, heat-processed soy grits and flour	1969
6	PAG Guideline for preclinical testing of novel sources of protein	1970
7	PAG Guideline for human testing of supplementary food mixtures	1970
8	PAG Guideline on protein-rich mixtures for use as weaning foods	1971
9	PAG Guideline on fish protein concentrate	1971
10	PAG Guideline on marketing of protein-rich foods in developing countries	1971

PAG Statements and Guidelines may be used and quoted freely. Copies may be obtained without charge from the FAO/WHO/UNICEF Protein Advisory Group, United Nations, N. Y. 10017, U. S. A.

MEETINGS

July 20 to 23, 1971	XTH INTERNATIONAL CONGRESS OF ANIMAL PRODUCTION. Association Francaise de Zootechnie	VERSAILLES, FRANCE
October 11 to 14, 1971	ASSOCIATION OF OFFICIAL ANALYTICAL CHEMISTS. Contact: L. G. Ensminger, Box 540 Benjamin Franklin Station, Washington	WASHINGTON, D. C., U. S. A.
October 13 to 15, 1971	NUTRITION AND TECHNOLOGY OF FOODS FOR GROWING HUMANS. Contact: Prof. J. C. Somogyi, International Union of Food Science and Technology	ZURICH, SWITZERLAND

December 6 to 9, 1971	CONVERSION AND MANUFACTURE OF FOODSTUFFS BY MICROORGANISMS. Contact: Y. Ayukawa, International Union of Food Science and Technology	KYOTO, JAPAN
March 19 to 25, 1972	4TH INTERNATIONAL FERMENTATION SYMPOSIUM. Contact: Prof. Gyozo Terui, Osaka University, Osaka 565, Japan	KYOTO, JAPAN

DISTRIBUTION OF PAG DOCUMENTS

1. PAG Bulletin:

a) No. 10, December 1970

U.S.A.	632
Foreign	880
United Nations Missions and Agencies	667
	2179

b) No. 11, April 1971

U.S.A.	791
Foreign	973
United Nations Missions and Agencies	667
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c) Present mailing list, 30 June 1971

U.S.A.	807
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United Nations Missions and Agencies	667
	2489

2. Breakdown of present Bulletin mailing list by continent:

North America (U.S.A. and Canada)	854
Central America, Mexico and Caribbean	47
South America	91
Europe	471
Africa	123
Oceania	18
Asia	218

3. Other documents:

Total number of requests for statements, guidelines and other documents filled from January through June, 1971, was 831.

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Winter 1971

Volume 2, Number 1, 1972

28/2/72
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PAG

Bulletin 13

Protein Advisory Group of the United Nations System
United Nations, N.Y. 10017
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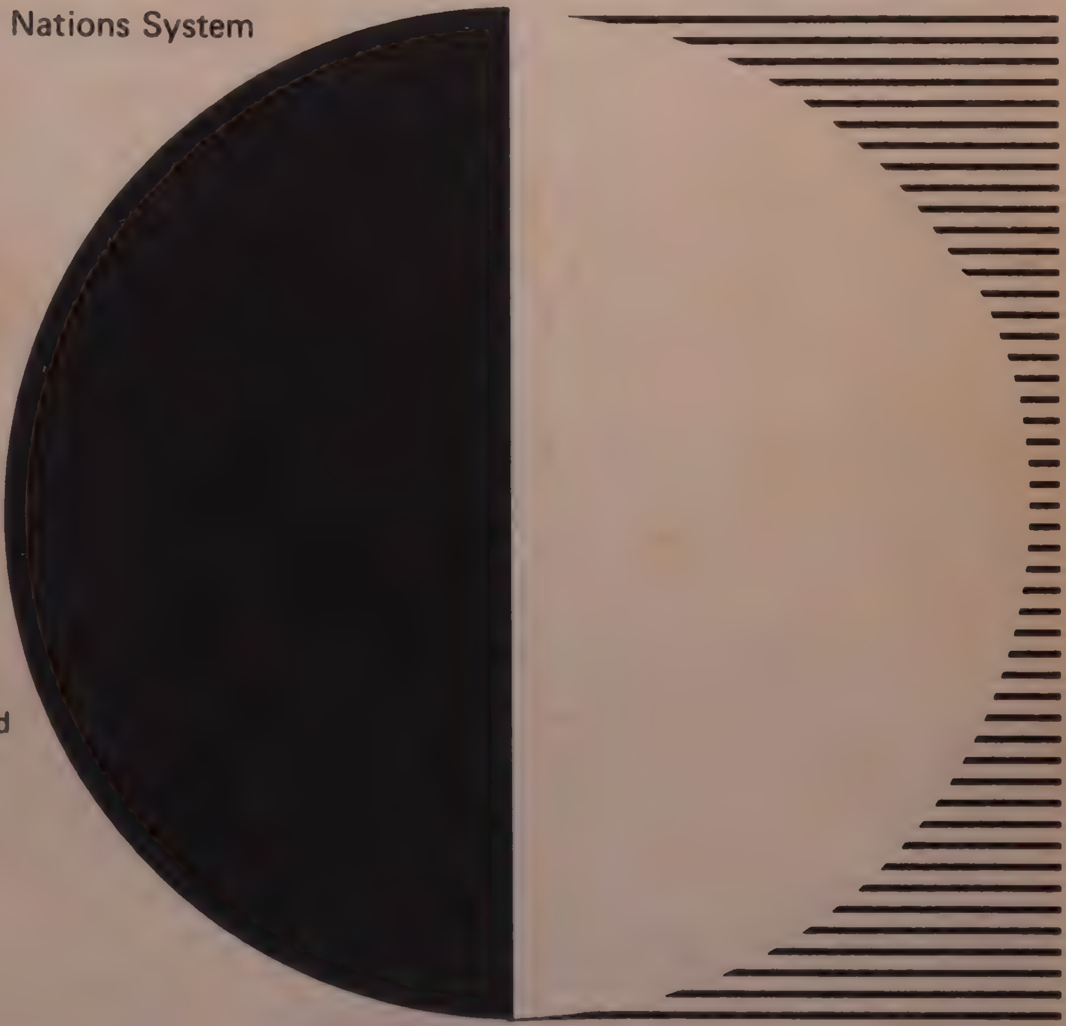

International review of action to improve world protein nutrition

THE PAG BULLETIN

PURPOSE

The *PAG Bulletin* is published by the Protein Advisory Group of the United Nations System. Its purpose is to give information on the world protein problem to those individuals, academic institutions and industrial organizations who are interested in helping solve the protein problem and to promote the exchange of information in this field.

MAILING LIST

The *PAG Bulletin* is sent without charge to persons, organizations, and companies with an active interest in proteins. The present mailing list comprises about 3000 names, approximately forty per cent in the U.S.A. and the rest distributed throughout the rest of the world. Requests to be added to the mailing list for the *PAG Bulletin* should be addressed to the Executive Secretary, Protein Advisory Group of the United Nations System, United Nations, N.Y. 10017, U.S.A.

QUOTATION

Permission to quote items from the *PAG Bulletin* is not required except from authors of signed articles. The Secretariat of the PAG would appreciate being informed of quotations made from the *PAG Bulletin*.

SUGGESTIONS

The *PAG Bulletin* will be successful only if it reflects all aspects of the protein problem comprehensively and objectively. The Secretariat invites suggestions and ideas for broadening and deepening the scope of the *PAG Bulletin*.

SECRETARIAT

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NOTE BY THE EXECUTIVE SECRETARY

This issue of the Bulletin appears at a time when the work of PAG has achieved a new level of significance in assisting the Agencies of the United Nations to deal with the serious global problem of protein-calorie malnutrition. Responding to the report of the Secretary-General's Expert Panel on Protein Strategy (reviewed in PAG Bulletin 12) the agencies sponsoring PAG have agreed that it will henceforth be known as the Protein Advisory Group of the United Nations System. The United Nations Economic and Social Council at its meeting in August 1971 considered the report of the Expert Panel and recommended inter alia that greater emphasis on this problem should occur in national development planning, that governments of developed countries should intensify their support for corrective programmes by means of bilateral and multilateral action and that UNDP should advise its representatives of substantive portions of the report in order that the protein problem might receive the attention of government planners at the highest level. With specific reference to the role of PAG, the ECOSOC resolution (presented in full elsewhere in this Bulletin) calls for participation in PAG by appropriate United Nations organs and Agencies, attendance of PAG experts at discussions of the protein question at meetings of Agency governing bodies and the presentation annually by PAG of a report to the United Nations on problems encountered and progress achieved in the solution of the protein gap.

One consequence of these recommendations is that the International Bank for Reconstruction and Development (IBRD) has become a sponsor of PAG and it is expected that other Agencies of the United Nations concerned with world protein and malnutrition problems will also soon join in sponsorship. It is anticipated that during its current 26th session, the United Nations General Assembly will endorse the ECOSOC resolution and call for greater international concern and effort in attacking the protein-calorie malnutrition problem.

At the 19th Meeting of PAG in Geneva in December, the implications of these developments to PAG's work programme and to possible enlargement of its services to the United Nations and its Agencies, will be considered. It is clear in any event that progress in alleviation of global protein-calorie malnutrition on any effective scale will require evidence of much greater concern and provision of larger resources on a sustained and long-term basis by Governments and the International Agencies which assist them. The recent events in the United Nations hopefully presage such necessary developments.

Max Milner

MEETING OF THE PAG AD HOC WORKING GROUP ON SINGLE CELL PROTEIN

The second meeting of the PAG ad hoc Working Group on Single Cell Protein was held at the Institute of Nutrition of the U. S. S. R., Academy of Medical Sciences, in Moscow, U. S. S. R. during 7-10 June 1971. Dr. K. V. Ananichev, Director of the Department of International Organizations, State Committee of Ministers for Science and Technology, opened the meeting and underlined the interest that the Government of the U. S. S. R. has in the development of the technology and the utilization of SCP in animal feeds and in due time and under safe conditions in human foods.

Members of the Group present were Professor A. A. Pokrovsky (Chairman), U. S. S. R.; Professor A. E. Humphrey, U. S. A.; Dr. B. L. Oser, U. S. A.; Professor N. S. Scrimshaw, U. S. A.; and Professor J. C. Senez, France. Professor Ivan Malek, Czechoslovakia, did not attend. Mr. J. Hutchinson, FAO, Dr. E. M. DeMaeyer, WHO, and Dr. A. Burgers, Unesco, also participated. Dr. S. R. Tannenbaum, U. S. A., attended the meeting as a consultant and Dr. O. Ballarin, PAG Member, Brazil, as an invitee. The following scientists of the Nutrition Institute of the Board for the Microbiological Industry, the State Committee of the U. S. S. R. Council of Ministers for Science and Technology and the invited representatives of research institutions and of industry from different parts of the world attended the plenary sessions: Miss G. Clement, France; Dr. J. Hoogerheide, Netherlands; Dr. J. Mauron, Switzerland; Dr. Wolfgang Pabst, Federal Republic of Germany; Dr. C. A. Shacklady, England; Dr. Carl J. Soeder, Federal Republic of Germany; Professor A. Spicer, England; Mr. Fumio Tanaka, Japan; Drs. A. N. Andriasov, T. A. Braksh, J. A. Ilyichiv, A. A. Scladnev, V. I. Seregin, A. Z. Yakovenko, and A. M. Zubets, U. S. S. R. The PAG Secretariat was represented by Dr. G. D. Kapsiotis.

General safety

The Working Group emphasized the absolute necessity of thorough preclinical studies, as outlined in PAG Guideline No. 6, "Preclinical Testing of Novel Sources of Protein", of any new single cell protein product before proceeding to clinical testing. This applies not only to products derived from different species of single cell organisms but also to those obtained by cultivating a standard organism on different or modified substrates and to those produced when processing changes have been made. This requirement for prior testing in experimental animals also applies to organisms grown on chemically pure substrates, such as glucose, methanol and ethanol, as well as more heterogeneous substrates such as molasses, sulphite liquors and petroleum hydrocarbon fractions.

Nucleic acid content

New evidence presented to the Working Group indicated that the effect of feeding nucleic acid on serum and urinary uric acid levels is not dependent wholly on the absolute amount of nucleic acid in the diet, but also on its origin. For example, nucleic acid extracted from liver does not produce as great an effect as that obtained from bacteria and yeast. However, these differences are not sufficient to require change in the present method of expressing tolerance limits for dietary nucleic acid; the presently specified limit of 2g/day of nucleic acid from single cell protein added to an ordinary mixed diet continues to represent an acceptable level of intake. Nucleic acids should not be considered toxic substances, but rather physiological ones with certain tolerance limits. The problem of lowering nucleic acid content is mainly a problem of reducing the amount of ribosomal RNA. Several methods exist for the removal of RNA from intact cells without excessive loss of cell protein. Regulation of culture conditions can be combined with the physical extraction of RNA with organic solvents or buffer solutions. Hydrolysis under acid or basic conditions may be useful. Although plasmolytic methods are effective for the isolation of highly polymerized RNA, their suitability for food production is complicated by the difficulties of removing all traces of the extracting medium. Other methods involve the activation of specific enzymes which hydrolyze RNA. A third method uses a ribonuclease from a separate source to treat either cells or cell isolates.

It was recommended that a base ratio analysis of the RNA of the specific organism be determined to aid in the interpretation of the results of uric acid analyses in human feeding trials.

Nutritional value

When intended for human consumption, the nutritional evaluation of SCP products as determined by animal bioassays must be supplemented with studies on human subjects. It has been shown that when no toxic elements are present, the protein value of most properly processed SCP products is quite adequate, i. e. comparable or superior to that of oilseed and grain legume preparations and comparable to that of many proteins of animal origin. It can be further improved by methionine supplementation. The proteins of all SCP products are susceptible to heat damage or to alteration by other improper processing, which may cause a considerable decrease in nutritional value. There is therefore important reason for determining the protein value of the final food products containing SCP.

Potential food uses

SCP is an excellent source of protein and the B vitamins. It can be added to foods in significant amounts to improve their protein value and supplement their vitamin content. In general, for organoleptic and other reasons, the quantity of SCP that can be incorporated into foods will be limited. Improved SCP materials of pleasant or bland taste which can be used at considerably higher ratios than the supplementary product have not yet been produced.

The material prepared by the Lord Rank Research Centre from a microfungus (Fusarium sp.) is stated to be a potential food in itself, capable of a variety of textural modifications, including chewy and/or crisp structures. The material produced by Esso-Nestlé (Acinetobacter sp.) is reported to be of neutral taste and colour suitable for incorporating into foods at levels ranging from 10-40%. The large variety of food products investigated includes bread, biscuits, macaroni, snacks, dehydrated soups, spreads and dairy products. The SCP addition is stated to result in a substantial improvement of nutritive value of these products without detriment to taste or texture.

The use of novel protein sources for animal feeding

In the development of new sources of protein intended for the feeding of domestic animals, it is essential that the resulting animal food products have the same nutritional quality, safety and acceptability as those of animals which receive conventional feeds. Research in a number of countries has established the need for regulation of such feedstuffs since problems seem to vary with the nature of the material and the specific methods of manufacture as well as whether they are designed for ruminant feeding or for poultry and swine rations. The need for guidelines for evaluation of the suitability of new protein sources for feeding of food-producing animals was stressed.

The use of SCP produced from either conventional or nonconventional raw materials as sources of proteins and other essential nutrients in animal feeds requires quality control to avoid the possibility of accumulation of harmful substances in the tissues of animals or in animal products such as eggs and milk which could be communicated to man.

Feasibility of small- and large-scale production

The Working Group noted that SCP production has progressed beyond laboratory scale. Commercial- and semicommercial-scale plants for SCP production from hydrocarbons exist in England, France and the U. S. S. R. Construction of an industrial-scale plant is underway in Japan. Yeast plants for the production of animal feeds from sulphite waste liquor and molasses have been in operation for a considerable time. In spite of this, toxicological problems with the use of SCP both in animal and human feeding still have not been sufficiently resolved to ensure fixing of process designs. It was therefore felt that the economic data based on an optimal scale of operation may not be valid.

The optimal design capacity of plants producing SCP from different kinds of raw material and meeting all safety standards is determined by specific economic conditions related to demand, marketing possibilities, raw material supply, and fuel, power and labour resources.

The Working Group noted with some concern that biotechnological developments in SCP processes do not seem to have received the proportionate attention that has been given to microbial screening activities and toxicological testing of SCP. It is recommended that steps be taken to encourage basic research on such biotechnological problems as the mechanism of microbial growth on oil-water and solid-water dispersed systems; optimal design of fermenters with minimal power requirements; methods of RNA removal or its limitation in cells, etc.

Substrates

The Group noted that research is under way on the use of a variety of substrates for SCP production. Included among the various possibilities are:

Hydrocarbons
Natural gas
Crude oil fractions
Purified n-paraffins

Carbohydrates
Sugars
Starch
Wood hydrolyzates

Alcohols derived from natural gas and crude oil
Methanol
Ethanol

Agricultural wastes
Bagasse and pulp
Citrus wastes
Whey
Wood pulp waste

Domestic and industrial wastes
Molasses and other sugar industry wastes
Sewage
Garbage
Food plant wastes

CO_2
Flue gas
Fermentation gas

Recycled animal wastes from:
Cattle
Poultry

Research should be encouraged to determine the economic as well as the technical feasibility of using these substrates. The use of carbohydrate materials as substrates should not be neglected. In many developing countries there are large quantities of molasses, vegetable and fruit wastes, and cassava which are not presently fully utilized and which could be available at low and even negative costs for fermentation processes.

Proteins of algae and microfungi

The Group reviewed the information provided by industry representatives on the extensive development studies on the use of Spirulina, Scenedesmus and microfungi undertaken at the Institut Français du Pétrole, France; the Kohlenstoffbiologische Forschungsstation, Federal Republic of Germany; and the Lord

Rank Research Centre, England. (Reported separately on p. 19). It was felt that the data were insufficient to justify conclusions regarding safety of the materials for human use or their economic feasibility.

The preparation of a guideline for the production of SCP for human consumption was an important item on the agenda and the Group had a detailed discussion on the draft guideline provided by Dr. S. Tannenbaum. The guideline will be placed before the PAG at its 19th Meeting for approval before issue. The Group also reviewed the PAG Guideline No. 6 "Preclinical Testing of Novel Sources of Protein" with special reference to the need for elaboration in the context of its application to SCP. Several useful suggestions have been made for the revision of the guideline.

Research and development liaison

In order to optimize available research resources and to avoid duplication, liaison should be established among laboratories engaged in the development of potential SCP processes and products. Such liaison could provide a basis for technological cooperation on the development of SCP processes useful in both the industrialized and the developing nations. It is important that countries with limited technical resources not be encouraged to incur major investments in SCP laboratories or pilot plants until the economic feasibility of the proposed types of SCP has been clearly demonstrated. It is recognized that regional conditions, particularly with respect to utilization of wastes as substrates, require study in the locality in which the production is proposed. However, to the greatest extent feasible the developing countries should avail themselves at present of the facilities in the industrialized nations for SCP investigations rather than create their own.

There is also a need to identify, and in some cases establish, centres in a number of appropriate regional or national institutions in areas in which major raw materials are available, for the purpose of determining the food and feed uses to which specific SCP products might be put. Such centres should be concerned with local conditions of food and feed processing, storage, distribution and marketing and be capable of training workers in these aspects of SCP development.

The Group felt that the exchange of technological, economic and experimental information between industry and research institutions (governmental or private) during this meeting was very useful and that PAG might take the initiative for convening a small conference or seminar in 1973 to which all agencies, industries and institutions having an active interest in SCP would be invited.

RESOLUTION ADOPTED BY THE ECONOMIC AND SOCIAL COUNCIL

1640 (LI). EDIBLE PROTEIN

The following is the text of the Resolution, dated 9 August 1971

"The Economic and Social Council,

Feeling that the Secretary-General's report on edible protein (E/5018 and Corr. 1), distributed too late to be the subject of detailed examination by the Council, deserves further and more comprehensive study by national Governments and all appropriate inter-governmental bodies of the United Nations system,

"Concerned at the critical edible protein situation in the developing countries,

"Convinced that urgent and concerted effort is needed to avert a crisis,

"Recognizing that in the United Nations system technical expertise at present exists in the FAO/WHO/UNICEF Protein Advisory Group,

"Further convinced that the developing countries themselves must play a major role if a crisis is to be averted,

"Recognizing that a basic problem is the question of spreading awareness of the acuteness of the problem, and of the means of dealing with it, at the appropriate governmental levels in both the developed and developing countries,

"Recognizing further that the appropriate national policy-level representatives convene at present on a regular basis in the meetings of the legislative bodies of the United Nations Children's Fund, the Food and Agriculture Organization of the United Nations, the United Nations Educational, Scientific and Cultural Organization, the World Health Organization and other appropriate United Nations organizations,

"1. Commends the Secretary-General for his report and the strategy statement of the high-level panel of independent experts, prepared in response to General Assembly resolution 2684 (XXV) of 11 December 1970;

"2. Requests the Administrator of the United Nations Development Programme to circulate the substantive portions of the report (chapters I, II, III and the annex) to the resident representatives of the Programme, with a view to maximizing their efforts and collaboration with the various Governments, so that this very important problem can be brought more forcibly to the attention of the national development planning officials at the highest possible level;

"3. Urges that greater emphasis in meeting this problem be placed on national development planning;

"4. Urges also the Governments of developed countries Members of the United Nations to reinforce their support for programmes and projects dealing with the problem on bilateral and multilateral levels;

"5. Recommends the appropriate United Nations organs and the specialized agencies to participate in the FAO/WHO/UNICEF Protein Advisory Group, in order to broaden its activities, and continues to urge the expansion of that Group to include all the organizations concerned;

"6. Requests the legislative bodies of the United Nations Children's Fund, the Food and Agriculture Organization of the United Nations, the United Nations Educational, Scientific and Cultural Organization, the World Health Organization and other appropriate bodies of the United Nations family of organizations, including the Advisory Committee on the Application of Science and Technology to Development, to incorporate in their agendas as a major topic of consideration, at the earliest possible date, the discussion of the strategy statement for solving the protein gap as contained in chapters I, II and III and the annex of the report of the Secretary-General and that appropriate experts of the Protein Advisory Group be invited to participate in the consideration of the strategy before these bodies;

"7. Requests the Protein Advisory Group to submit to the appropriate intergovernmental bodies of the United Nations system an annual report giving an analysis of the progress and problems encountered in the solution of the problem of the protein gap, with suggestions and options for possible courses of action by these intergovernmental bodies."

FAO CONFERENCE ACTION ON PROTEIN

The following is an extract from the report of the sixteenth session of the Conference of the Food and Agriculture Organization relating to the question of increasing the production and use of edible protein, including resolution 7/71 adopted by the Conference on 22 November 1971.

"172. The Conference also considered a document[1] on the production and use of edible protein which contained relevant chapters of the Strategy Statement on Action to Avert the Protein Crisis in the Developing Countries, prepared by a panel of experts and submitted by the Secretary-General of the United Nations to the Fifty-first Session of ECOSOC.

"173. The Conference also heard a statement by Professor Bo Vahlquist, a member of the Protein Advisory Group of the UN System (PAG) who, in accordance with a recommendation contained in ECOSOC Resolution 1640 (LI), had been invited by the Director-General to participate in the discussions. Professor Vahlquist expressed appreciation of the positive response of FAO to the ECOSOC resolution mentioned, and outlined the origins and activities of PAG with an indication of the manner in which it would assist the members of the UN System in solving the problem of malnutrition. In paying tribute to FAO's contribution to progress in the protein field, he stressed the need for continued and expanded co-operation among the agencies of the UN System, with a view to solving increasingly urgent problems such as those of the pre-school child.

"174. The Conference attached great importance to an intensification of the measures necessary to solve protein malnutrition, and in this connexion recalled the suggestions made in the course of the discussions of the Programme of Work and Budget and the Medium-Term Plan.

"175. The Conference was also informed of the Director-General's proposal[1] that the problem of closing the protein gap should be the subject of another major item for discussion at the 1972 FAO Regional Conferences. This would bring the subject, which was of basic importance to social and economic progress, more forcibly to the attention of national planning officials at the highest level.

"176. The Conference agreed that the FAO Council should undertake a comprehensive review every year of the contributions being made by the FAO towards a solition of the malnutrition problem, within the framework of certain broad guidelines.

"177. The Conference then adopted the following resolution:

"Resolution 7/71

"Increasing the Production and Use of Edible Proteins

"The conference,

"Recognizing FAO's leading role and constitutional responsibility in raising levels of nutrition and standards of living of the populations of the world,

"Recalling Resolution 2/69 of its Fifteenth Session on closing the protein gap,

"Noting with satisfaction the further developments in various other intergovernmental bodies designed to intensify measures in this important sector and notably the recent ECOSOC resolution 1640 (LI) on edible protein,

"Noting in particular the substantive chapters of the report of the Expert Panel on "action to avert the protein crisis in the developing countries" submitted by the Secretary-General to the Fifty-First Session of ECOSOC,

"Noting further the close correlation between these substantive recommendations and the broad lines of action of FAO envisaged in its Programme of Work for 1972-73, in the Medium-Term Plan, and the Director-General's statement of intent to intensify further FAO's work, notably in fields of nutrition surveys, semi-conventional proteins and special feeding programmes,

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[1] C71/46.

"Welcoming the action taken by the Director-General in co-operation with others, in promoting the expansion of PAG to serve the UN system as a whole, and in accordingly having it renamed the "Protein Advisory Group of the UN system",

"Noting with satisfaction the recent decision of the IBRD to become a sponsor of the PAG, which also reflects its interest in including action to improve levels of nutrition in its future programme,

"Recalling finally the importance given to the need for raising further the levels of nutrition, food production (particularly protein foods) and food utilization in the goals of the Second Development Decade,

"1. Decides that the Council should undertake a comprehensive review every year of the progress being made by the Organization, in its contribution within the over-all UN effort, to solve the protein problem and to provide it with appropriate recommendations;

"2. Invites the Council for this purpose to consider setting up a body of seven members to review the work of the Organization in this field;

"3. Commends to the Council the following draft statement of recommendations for consideration:

"RECOMMENDATIONS FOR ACTION

"1. General approach

(a) The solution of the protein problem should be sought as part of the answer to the malnutrition problem as a whole, in the context of economic and social development.

(b) The prime responsibility rests with the government of the country suffering from malnutrition, and should be expressed in the formulation of a national food and nutrition policy as part of planned development.

(c) The long-term solution to protein/calorie malnutrition will be found in the increase in purchasing power of the populations affected, especially those in the lower income groups, supported by effective programmes for nutrition education and other long-term action.

(d) To improve the present situation without delay, immediate action is required on the part of governments to initiate and implement special programmes directed to improving the protein/calorie nutrition of vulnerable groups of the population: namely, expectant and nursing mothers, infants, pre-school children and school children.

"2. Long-term Activities

(a) To provide a firm basis for formulating food and nutrition policies, food consumption and household budgetary surveys designed to relate existing consumption patterns to the economic status of the household and to standards of nutrition are necessary.

(b) At national level increased production of foodstuffs, particularly protein foods, to meet energy requirements and needs for protein, minerals and vitamins are urgently needed to improve existing standards of nutrition and to provide for population increase.

(c) Government planners should be trained in food policy and food economics.

(d) To increase purchasing power and to achieve redistribution of income every effort must be made to raise levels of employment, thus leading to better levels of nutrition and augmented production capacity.

(e) To improve the use of available food, nutrition education of the general public and nutrition training for agricultural personnel and school teachers is of major importance.

"3. Short-term Activities

(a) The most important way to reach the low income groups in developing countries requiring supplementary feeding is through feeding programmes using both conventional and semi-conventional foods as appropriate. These feeding programmes must be designed and directed specifically to the particular groups concerned. FAO should assist governments in setting up such programmes using local foodstuffs and foods contributed by WFP and UNICEF.

(b) To reach the vulnerable groups themselves it is necessary to prepare foods specially formulated so that energy, protein, minerals and vitamins are concentrated into a bulk which can be consumed to meet nutritional requirements. Such foods should be prepared on a commercial basis from locally available raw materials, possibly with initial assistance from WFP.

(c) Governments, having responsibility for improving nutritional status, can help in the commercialization of formulated protein foods by purchasing them for inclusion in nationally supported feeding programmes conducted through ministries of health, labour and social welfare and departments of education in school feeding programmes.

(d) With the advice of the Protein Advisory Group, means to incorporate new and unconventional sources of food acceptable to the population needing them should be studied and implemented where possible. Single-cell protein and amino acid fortification are examples.

(e) Programmes need to be developed to prevent waste of foodstuffs through control of diseases in plants and animals; through improved storage, processing, distribution and marketing; and by the development of food legislation and food quality control.

(f) Since most of the food distributed by WFP goes to recipients in most need of improved nutrition, the enlargement of its resources, especially in protein foods, will make a substantial contribution to reducing malnutrition.

"4. Action by FAO

FAO's activities, taking into account the report of the Expert Panel, will place particular emphasis on the following points:

- assistance to Member Governments in the development of food policies and plans by conducting food consumption and household budgetary surveys;
- the organization of seminars or short courses in food policy and food economics for government planning staff;
- assistance in stepping up the production, processing and distribution of conventional high-protein foodstuffs (legumes, meat, milk, fish and cereals of high-protein quality);
- help to countries in the formulation, commercialisation and promotion of protein-rich foods for the vulnerable groups;
- support for government feeding programmes for school children, workers and others at risk of malnutrition;
- assistance in nutrition education and the best use of family resources through such programmes as Planning for Better Family Living;
- urgent attention to the design and application of measures to increase awareness of the problem and of its far reaching consequences on the well-being of present and future generations in all countries;
- intensification of co-operation with other members of the UN System, especially the financing organizations, namely UNDP, UNICEF, IBRD and WFP and possible bilateral sources of assistance in order to increase the resources necessary for implementing practical programmes of action."

PAG AD HOC WORKING GROUP MEETINGS

Two recent meetings were held in Washington, D.C., U.S.A. The ad hoc Working Group on Feeding the Preschool Child held its meeting on 26-28 October 1971, and was followed by a meeting of the Working Group on Milk Intolerance - Nutritional Implications on October 29 and 30. Reports of these two meetings will appear in the next issue of the Bulletin.

PROCESSING DAMAGE TO PROTEIN FOODS[*]

by Dr. Arnold E. Bender, Queen Elizabeth
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The effect of treatment on protein foods must be discussed in the context of three principles:
1) Changes in nutritive value are only important if the food comprises a reasonable proportion of the diet;
2) inadequate methods of assessing the nutritive value can lead to false conclusions, thus BV, NPU, PER and GPV will reveal changes only when the limiting amino acids are affected; and
3) many diets are limited by sulphur amino acids, and in these cases the much-investigated Maillard reaction involving lysine is of less interest.

For its effect on protein quality, heat is the most important food treatment. It can be beneficial or detrimental. Loss in nutritive value can result from different reactions: loss of palatability, destruction of amino acids by oxidation and delayed or inhibited release of amino acids during digestion due to modification of linkages between amino acids.

The main factors controlling the extent of the damage are temperature, time of heating and presence of moisture and reducing substances. In general, little damage takes place in normal kitchen and plant procedures. Cereals are not affected when cooked in water and damage during baking is limited to the outer layer. Only the puffing-exploding process used for certain breakfast cereals and biscuits causes severe damage. In milk, small losses of lysine may occur under normal processing but since milk proteins are limited by methionine, this will not be revealed by biological assay. Home cooking has very little effect on the nutritive value of meat.

While optimum conditions have been established for many processes, examination of commercial samples has shown considerable damage. Not enough attention has been paid to the control of manufacturing conditions.

Three principles form the background to any discussion of the effects of treatment on the nutritive value of protein foods.

First, changes in the nutritive value of any food will be of no importance unless the food comprises a reasonable proportion of the diet. For example, some of the processes involved in the manufacture of cereal foods (breakfast cereals) cause considerable destruction of the protein, but the amount of such food that is normally eaten provides so little protein that the damage has an insignificant effect on the diet.

Second, inadequate methods of assessing the nutritive value of the protein can lead to false conclusions. For example, biological measures such as biological value (BV), net protein utilization (NPU), protein efficiency ratio (PER), and gross protein value (GPV) will reveal change only when the treatment affects the limiting amino acid; changes in other amino acid levels are not revealed by these methods. Milk, many oilseed cakes and fish meals are limited by methionine plus cystine and contain a relative surplus of lysine; if the amount of available lysine is reduced there will be no change in the biological measure until the damage is severe enough to make lysine limiting.

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[*] A paper presented at the 18th PAG Meeting, Rome, 1971.

Third, if, as available evidence suggests, many diets tend to be limited by the sulphur amino acids, then only damage to these is of real interest in such diets. The much-investigated Maillard reaction involving lysine would be of interest only when this amino acid is limiting in the diet as a whole.

In order to preserve foods, to make them palatable or to add to their variety or novelty, they undergo many processes including drying, heating, irradiation, freezing, and chemical treatment, and they may also be subjected to long periods of storage. Of these treatments heat is the most important in its effect on protein quality and it can be both beneficial and detrimental (28).

Beneficial effects of heat

The nutritive value of most if not all legumes is improved by heating. This is partly due to the destruction of trypsin inhibitors and toxic substances and partly to improved digestibility and availability of the sulphur amino acids. Soybeans in particular have been extensively studied and it has been well established that to obtain a product of the highest nutritive value the application of heat must be a balance between beneficial and destructive effects (28). Raw groundnut fed at 15% protein level causes pancreatic hypertrophy in rats because of the trypsin inhibitor (1). Autoclaving or dry heat at 121°C for 30 minutes reduced this inhibitor to 50% with a slight rise in NPU; when heating was continued for 4 hours there was a fall in available lysine but no change in the methionine.

Similar beneficial effects have been reported with cereals, but the results appear to be due to inadequate assay methods. For example, it was reported (68) that the PER of whole wheat flour was increased from 1.65 to 2.04 on heating the dough to form chappatis, but it was later shown (57) that this increase was caused by the higher consumption of the cooked product by the experimental animals and that the NPU of the flour, measured on chicks, did not show any change on cooking.

On the other hand, changes have been found in the availability of several amino acids on milling wheat and baking the flour (32). Methionine, tryptophan and threonine were more available in bread than in unground wheat, the availability of isoleucine increased from 73% to 91% when the wheat was milled and decreased to 70% when the flour was baked and the availability of leucine decreased from 94% to 75% on milling and increased to 100% on baking.

Wheat, rye and buckwheat, and to a lesser extent rice, oats and maize, contain a trypsin inhibitor (43). Cooking of rice, wheat and oats destroys the inhibitor but does not do so in the other cereals.

Protein damage

Processing damage to proteins can result from four different types of reactions; namely destruction of amino acids by oxidation, loss of palatability, modification of some of the linkages between the amino acids so that their release is delayed during digestion, and formation of linkages that are not hydrolyzed during digestion, i.e. loss of biological availability.

The destruction of amino acids or of protein can be seen in the obvious charring that accompanies gross overheating.

With regard to unpalatability, it was found (7) that overheated fish products developed "a foul smell and very dark colour" although the fall in GPV was only 28%. A similar loss of palatability without a fall in nutritive value has been reported (64). This, however, does not appear to be an important practical problem.

The explanation of the third type of damage due to delayed release of amino acids during digestion is, it is suggested, that not all the essential amino acids are available at the same time for protein synthesis in the tissues and those that cannot be so used are oxidized. There is evidence that the rate of liberation of amino acids by enzymes *in vitro* can be changed by heating (11, 54).

Apart from the need for all the amino acids to be present at the site of synthesis at the same time, energy is also necessary and if it is not available in sufficient quantity at the time needed some part of the amino acids will be oxidized and the nutritive value of the dietary protein reduced. For example, several workers have reported that when sucrose replaces starch in the diet there is a fall in the nutritive value of the protein (26, 27, 41). This is explained by the rapid absorption of sucrose compared with the more continuous supply of energy from starch; the latter accompany the relatively slow and continuous release of the amino acids during digestion. A reduced growth rate on casein plus methionine when sucrose replaced starch in the diet has been found (26), but no difference when an amino acid mixture was used. Sucrose, compared with starch, depressed growth when the dietary protein was alpha-soy protein but not when the soy was heated or replaced by casein (65). The amino acids were liberated slowly from the untreated soy protein, paralleling the absorption of energy from the starch, while the rapid absorption of energy from sucrose presumably left part of the amino acids without an adequate calorie supply for protein synthesis. This mechanism may be the reason for the hitherto unexplained finding that an amino acid mixture or casein hydrolyzate fed to man required more energy for nitrogen balance than did whole protein (66). Rapid absorption of the amino acids without a simultaneous supply of energy would result in oxidation of part of the nitrogen; this could be prevented by a higher energy supply in the diet. Evidence comes from a further observation (66) that enzymically hydrolyzed casein, containing whole peptides and presumably therefore more slowly absorbed, was intermediate between the amino acid mixture or acid hydrolyzate and the whole casein.

Thus it is likely that the nutritive value of proteins may vary with the rate of absorption of the energy supply, i.e. with the type and quantity, and that heat may affect the nutritive value of proteins by altering the rate of release of the amino acids during digestion, but there is little direct evidence.

Nonavailability. The mechanism of protein hydrolysis during digestion is far from clear since it is not possible to reproduce the operation *in vitro*; under these conditions hydrolysis is only about 50% complete. Nevertheless, it has been well established that under certain conditions heat can create linkages that cannot be hydrolyzed during digestion so that part of the amino acids are not absorbed. For example, when a casein-glucose mixture was autoclaved for two hours at 121°C the linkages formed were resistant to trypsin and papain *in vitro* but digested by pepsin, chymotrypsin and pancreatin (48).

It is clear from recent work that many if not all the amino acids can suffer a reduction in their availability, although earlier work was largely devoted to the lysine-Maillard reaction. The types of damage so far elucidated are: 1) reaction between the amino groups of the amino acids and a reducing substance (in the case of lysine the terminal amino group becomes bound but little is known of the reactions of the other amino acids); 2) reaction between the terminal amino group of lysine and the carbonyl secondary decomposition products of autoxidizing fats; and 3) protein-protein interaction (carbon-nitrogen links) independent of the presence of reducing substances (18, 44).

The type of damage inflicted depends on the conditions. It has been shown that at temperatures below 100°C lysine is lost by reaction with autoxidizing fat, while at higher temperatures, 115-130°C, the loss is apparently independent of the presence of fat (45).

The most thoroughly studied has been the Maillard or browning reaction between the epsilon amino group of lysine and reducing sugars. The first stages of the reaction lead to the formation of a colourless compound and a brown colour is developed later. Under certain conditions the extent of browning may be an index of damage but it has been shown that the degradation of methyl histidine can give rise to an orange-brown colour (36) and that there is no constant relation between colour and loss of nutritive value (8).

Earlier work was concentrated on lysine as the sole seat of damage, and in certain foods and mixtures lysine appears to be the only amino acid that is damaged. For example, an examination of a mixture of wheat flour, egg, yeast, and lactalbumin was undertaken (5). The PER of the unheated mixture was 3.5, baking at 200°C for 15-20 minutes reduced this value to 2.4, and toasting to form a rusk at 130°C for 40-60 minutes reduced it still further to 0.8. The addition of lysine restored the PER to its initial value. Similarly, a mixture of wheat gluten and glucose showed a reduction in BV from 55 to 18 on heating, and a restoration to 60 on the addition of lysine (25).

The chemical analysis of protein, which is preceded by acid hydrolysis, does not yield information concerning the availability of the amino acids to the living animal. At the same time, biological tests such as NPU, BV, GPV, and PER measure only the limiting amino acid and give no information about the other amino acids unless multiple assays are carried out with various combinations of supplementary amino acids (2). Only direct measurement of the available amino acids provides the required information. Since these methods have been applied in recent years it has become clear that in some foods several, if not all, of the amino acids may be damaged at the same time (21).

In some foods the sulphur amino acids suffer more damage than does the lysine. In unheated fish, for example, methionine is the limiting amino acid and remains limiting in grossly overheated fish meal. Supplementation of these poor samples with methionine does increase the NPU but not up to the levels of undamaged material (3).

Similarly, in heated herring meal tryptophan, methionine, arginine and lysine are damaged (8). A microbiological assay of a variety of materials showed that the availability of several amino acids is reduced by about the same extent (21). In an enriched high-protein biscuit lysine, methionine and tryptophan were shown to be bound by heat treatment (51).

Recent work suggests that quite apart from the the nonavailability of amino acids, the Maillard compounds may be toxic (22). There is evidence that heating lysine, glutamic acid or alanine in air with glucose at 100°C can lead to the formation of various N-nitrosamines, known carcinogenic and mutagenic agents (13).

Factors controlling damage

It has been clearly established that the temperature and time of heating, and the presence of moisture and reducing substances, control the damage done to protein. Other factors may also be involved, as, for example, the pH. This differs in its effect on the rate of reaction of glucose with various amino acids (74).

Physical factors may also be involved; for example, a loss of 30% of the free amino groups in 24 hours at room temperature was observed in a casein-glucose mixture, mixed wet and dried together (46). Bender (unpublished) found that a similar mixture (an experimental diet based on casein and glucose) mixed dry showed no change in NPU after storage for one year in an unsealed container at room temperature.

In a sample of dried milk stored in a sealed can under nitrogen in a deep freeze the NPU fell from 74 to 53 in three years. A similar sample left open in the laboratory for the same length of time deteriorated to the same extent. In both samples it was the methionine that had been lost, since the NPU was restored to 73 on supplementation with this amino acid (3).

Gamma irradiation has some effect at high dose levels. Little effect on the BV of flour was found when doses of 20-200Krad were used for disinfestation (63), while doses of 0.6-3 Mrad (accompanied by heat sterilization and 3-9 months storage) damaged heterocyclic amino acids (20).

Temperature and time of heating. Damage is generally proportional to the extent of heat, i.e. time and temperature beyond a certain critical temperature. Casein, for example, is damaged at 120°C but not at 100-110°C, and above this critical temperature the amount of damage is proportional to the time of heating (24).

Blood plasma containing less than 0.1% carbohydrate was stable for 27 hours at 85°C but lost 27% of its available lysine at 115°C (8); the loss of several amino acids in a high-protein biscuit was shown to be proportional to time and temperature (51). Similarly, the lysine of bread was progressively lost during baking at times from 0 to 50 minutes (35).

Reducing substances. One of the major causes of the reduction in nutritive value, especially under mild conditions, appears to be the Maillard reaction between lysine and a reducing substance. There are numerous reports of the stability of protein to heat until a reducing substance is introduced into the system. A sample of wheat gluten heated alone was stable, but when glucose was added there was a dramatic fall in nutritive value from BV 55 to 18 (25). Supplementation of a biscuit with casein caused no loss on baking but when skim milk was used instead the lactose caused a 50% loss of available lysine (10). Haricot beans showed a greater loss when canned with glucose than when canned with sucrose or a mixture of glucose and sucrose (62). Oilseed cake which is relatively free from reducing sugars was more stable than a mixture of gluten and milk powder (22).

Very small quantities of reducing substances are capable of causing damage, as evidenced by the deterioration of dried egg during storage. There is only 1.2% glucose present, but when this is removed the egg becomes stable (29). The small amount of ribose present in certain species of fish, 0.4% of the dry weight, is sufficient to cause protein damage (72). While plasma albumin was unaffected by heating to 85°C for 27 hours, the addition of small amounts of ribose caused damage within one hour at the same temperature (8).

Moisture. Some classical experiments established that damage is most severe at 10-14% moisture (70% relative humidity) (46). The loss of available lysine is greatest at 4-14% moisture (8); dry materials are relatively resistant to heat (55) and boiling in excess water usually has no effect.

Foodstuffs

Wide variations in conditions make it difficult to generalize about the extent of protein damage suffered by common foods but it is fair to state that relatively little damage takes place under the conditions used in normal plant processing and in domestic food preparation.

Protein-rich supplements. Foodstuffs such as fish meals, meat meals and oilseed residues, used as supplements, can suffer considerable damage during the drying process unless the procedure is rigidly controlled.

In the past, commercial samples of fish meal, for example, have ranged from undamaged material with an NPU of 80 to samples with an NPU of 57; deodourized fish flours have ranged even more widely, from NPU 77 to 18 (4). Similar results have been reported with meat meals and oilseed cakes. Samples of fish meal have been dried with air in a flame dryer at a very high temperature without damage as long as moisture was still present while the heat was applied (73). Conversely, vacuum drying has sometimes resulted in damage.

It is noteworthy that sophisticated processing methods can result in damage (as indicated later) to dried milk and soy, while primitive methods of food technology, such as lake-dried fish from Africa and other sun-dried foods, can provide products without damage to protein (56).

Bread and cereals. The available evidence can be summarized by stating that there is no damage when cereals are cooked in water, that the damage accompanying baking is limited to the outer and consequently more severely heated portions, and that the only processes which cause severe damage are the puffing-exploding type used in the preparation of certain breakfast cereals and the baking of biscuits.

The effects of baking a cake-mix have already been mentioned; the PER of 3.5 was reduced to 2.4 on baking and to 0.8 on toasting (5).

An 11% loss of lysine was observed on baking bread, most of which occurred in the crust (67), and greater losses were found in smaller loaves (33). A quarter of the lysine and tryptophan were shown to be lost in the crumb, which is by far the greater part of the loaf, and three-quarters in the crust (23). Added lysine appears to be lost at the same rate as lysine present in the wheat protein (35). These losses are in European-type loaves which are usually baked at 250°C for 45 minutes and where the internal temperature does not rise above 95°C. No loss was found in Arab bread baked in a 1-cm layer for only one minute at 400-500°C (49).

Biscuits are an attractive vehicle for protein enrichment but are subjected to relatively high temperatures since they are baked to a low moisture content. Biscuits baked at 232°C had no loss of available lysine after 10 minutes, 9% loss after 20 minutes, 18% after 25 minutes, and 27% after 30 minutes (9). The addition of sugar up to 14.5% had no effect on the lysine but when the sugar level was 29% there was a 30% loss of available lysine in 20 minutes, i.e. three times the loss in the absence of sugar. With 58% sugar the loss was 65%. Added synthetic lysine was lost at the same rate.

Commercially-prepared breakfast cereals have been examined many times (59, 70, 71). The BV of whole wheat was not affected by cooking but was reduced by toasting. Rolled oats have a PER of 1.6, unchanged when the product is boiled for 15 minutes and dried for 15 seconds at 130°C or cooked for 1-2 minutes at 100-pound pressure, exploded and dried at 200°C for 1-2 minutes. However, when oats were puffed by heating for 5 minutes at 122°C, then at 200-pound pressure at 189°C for 2 minutes, there was a fall in the PER to 0.3. Breakfast cereals were shown to range in PER from minus 2.5 for puffed wheat to plus 1.7 for quick oats.

All these determinations were carried out on the rat and the question must arise as to how far these results are applicable to human beings. We generally accept results from the young growing rat as being approximately valid for man, but this relationship does not appear to hold for cereal products. For example, many results show that whole wheat has a BV of 60-70 in rats while in man it is about 90. Values obtained were 76 (39), 68 (6), 67 (58), and 64 (59) for the BV of whole wheat in rats. Values of 90 for shredded whole wheat and toasted whole wheat and 80 for puffed and flaked wheat were obtained in man (60). These results verify that some damage is caused by puffing and flaking, but the values obtained in adult man are considerably higher than those obtained experimentally on the growing rat.

Similarly, wheat germ has a value of 75 for the rat and 89 for man, but wheat gluten is 40 for both species. Oats also show higher results in man, namely 89, as compared with the rat at 66.

It must be borne in mind that laboratory rat assays can be replicated many times under controlled conditions while the difficult and laborious human assays are very few in number. For example, it is not possible to say whether wheat flour shows a difference between human and rat assays when the values obtained on man range from 40-70 while the rat figure is fairly precise at 52. Nevertheless, these findings throw considerable doubt, at least as far as cereals are concerned, on the straightforward application to adult man of results obtained on rats.

Milk. The proteins of milk are limited by methionine (plus cystine) and if minor damage reduces the lysine content this would not be revealed by biological assay unless carried out under conditions where lysine is deliberately made the limiting amino acid by supplementing the test diet with the other necessary amino acids. Apparent contradictions in the literature are thus reconciled since some workers claim that milk suffers no damage on heating, because the BV was not reduced, while others measured lysine itself and found small losses. However, losses are insignificant under normal processing conditions.

A small loss of lysine on concentrating milk but no loss on drying has been shown (34). Lysine in fresh milk was 8.9% of the protein; condensed, 7.4%; dried, 8.1%; and dried skim, 8.3%. Methionine was the same in all four samples. An 11% loss of lysine after a 15-minute sterilization at 116-118°C and a 26% loss after one hour heating under these conditions, at which stage the milk was unfit for consumption, was also observed (34). A 3.6% loss of lysine in spray-dried milk and 8.4% on evaporation was shown (50). Roller-dried milk dried at 100°C is damaged but no damage occurs to spray-dried milk (15). A 10% reduction in available lysine is reported when milk is sterilized (42). Many other workers have shown that no damage occurs during pasteurization (31) or evaporation and canning (77). A fall of 6% in BV on commercial sterilization has been observed (40) and a fall of 8% in the nutritive value of spray-dried milk was shown to be caused in the preheating stage (19).

Storage of dry skim milk of high moisture content results in a fall in nutritive value due to loss of availability of lysine (30). There are also losses of arginine, histidine and methionine on long storage (34). Dried milk of lower moisture content is more stable and storage under nitrogen is a further protection.

Meat. There is much evidence in the literature that home cooking has very little effect on the nutritive value of meat. For example, meat roasted in an open pan at 163°C, with an internal temperature of 80°C, had a BV (excluding the outer portions) the same as that of raw beef dried at 60°C, namely 79 (52). Even crisp frying of bacon did not reduce the nutritive value compared with the raw product (53). Canned meat, after being browned in the oven for 30 minutes and processed in jars for 85 minutes at 121°C, still had a BV of 74 (52). When this meat was corned, i.e. cured for 60 days in salts, the BV was still 76. A fall of 30% was found in the BV of beef on corning and canning but no further loss occurred after 9 years of storage (3). Heating for 3 hours at 70°C caused a 10% loss of available lysine; at 121°C the loss was 20%; at 140°C, 40%; and at 160°C, 50% (16).

When pork was heated in water at 110°C for 24 hours and dried at 100°C for 16 hours, the NPU fell from 76 to 41, available lysine fell by 34% and 20% was destroyed, and 16% of the methionine and 44% of the cystine were destroyed (14). The NPU was partially restored to a value of 60 by adding methionine.

A report (76) which appears to contradict some of these findings describes the examination of the amino acids in rat portal blood after feeding heated protein foods. Pork autoclaved for 2 hours at 120°C had a fall in PER from 2.1 to 1.7, accompanied by a smaller increase in the blood levels of the amino acids. It was concluded that the fall in nutritive value was due partly to slower liberation of the amino acids so that all were not available simultaneously for protein synthesis. This report would appear to be a direct contradiction of previous work (61) which showed no damage after more severe heating of pork during canning, namely 128°C for 3 hours with an internal temperature of 107°C, or after heating for 4 1/2 - 5 hours at 162°C with an internal temperature of 85°C. Since the internal temperature was not reported by the former investigators, it is not clear how far the experimental conditions differed in these different experiments.

Limited damage on freeze-drying of meat and greater damage on air-drying, measured by N balance on human subjects, has been reported (37).

Other foods. Some other foods show small losses during normal manufacturing processes. For example, no damage was reported to freeze-dried beef, chicken and maize, or to spray-dried cheese and a product made from egg, milk and cottonseed (12). Hot-air-dried cabbage and lima (butter) beans showed a small loss in BV.

The BV and digestibility of sardines were not altered by canning or by frying for 6 minutes at 180°C (75). The sterilization of buffalo milk under conditions of experiment reduced the available lysine by 10% compared with pasteurization or boiling (69). Irradiation caused a small loss of nutritive value of wheat and wheat gluten but not animal feeds and eggs (38).

Practical findings

It is clear that the variation between experimental conditions used by different workers is sufficient to account for the differences between their results. In a similar fashion, variation in procedure between different plants, and even in the same plant from day to day, would account for the variable protein quality of foodstuffs on the market. While the conditions for minimum damage have been well established it may not be easy to control these under manufacturing conditions.

Many of the investigations of factors affecting nutritive value have been carried out on model systems and isolated proteins, but the results apply equally to the complex mixtures that constitute foods. Now that the optimal processing conditions are known, it should be possible, and indeed it is, to prepare undamaged foods, yet the variability of plant conditions or lack of quality control is such that many manufactured foods still suffer protein damage. For example, the optimal conditions for processing soybeans so as to destroy toxic factors and bitter flavours yet not incur heat damage have been extensively investigated, but the commercial samples can show both considerable variability and loss of nutritive value (47). The PER of a number of soy concentrates varied between 0.3 and 1.9 but they could be improved to 2.1 on further heat treatment. Similarly, a number of soy isolates ranged from PER 1.4 to 1.8 and, with one exception, improved to 2.0 on heating. The exception was a sample that could not be improved beyond a PER of 1.5 and it was found to be overprocessed as indicated by the partial conversion of cystine to cysteic acid.

It is equally possible to dry skim milk without damage, yet an examination of commercial samples showed considerable damage (17). Sixteen samples of roller-dried milk had available lysine values ranging from 4.2 to 6.9; only half the samples reached a value of 6.3. The authors showed that the lower values were found in material dried on rollers manufactured before 1960.

Thus, although considerable attention has been paid to the development of methods for processing protein-rich foods, it would seem that less attention is paid to the quality control of these foods.

References

1. Anantharaman, K., and K.J. Carpenter. 1969. J. Sci. Food Agr. 20: 703.
2. Bender, A. E. 1954. J. Sci. Food Agr. 7: 305.
3. Bender, A. E. 1962. Proc. First Int. Cong. Food Science and Technology 3: 449.
4. Bender, A. E., and S. Haizelden. 1957. Brit. J. Nutr. 11: 42.
5. Block, R. J., et al. 1946. Arch. Biochem. 10: 295.
6. Boas-Fixsen, M. A., et al. 1934. Biochem. J. 28: 591.
7. Carpenter, K. J., et al. 1957. Brit. J. Nutr. 11: 162.
8. Carpenter, K. J., et al. 1962. Brit. J. Nutr. 16: 451.
9. Clark, H. E., et al. 1959. J. Am. Dietet. Assoc. 35: 469.
10. Clegg, K. M. 1960. Brit J. Nutr. 14: 325.
11. Cook, B. B., et al. 1951. J. Nutr. 44: 51.
12. De Groot, A. P. 1963. Food Tech.

Champaign 17: 339.

13. Devik. 1967. Acta Chem. Scand. 21: 2302.
14. Donoso, G., et al. 1962. J. Sci. Food Agr. 13: 192.
15. Durrenmatt, K. 1954. Proc. Symposium on Nutritive Aspects of Preserved Food: Swedish Inst. for Food Pres. Res., 95.
16. Dvorak, Z., and I. Vognarova. 1965. J. Sci. Food Agr. 16: 305.
17. Eibersdobler, H. and H. Zucker. 1966. Milchwissenschaft 21: 564.
18. Ellis, G. P. 1959. Advan. Carbohydrate Chem. 14: 63.
19. Fairbanks, B. W., and H. H. Mitchell. 1935. J. Agric. Res. 51: 1101.
20. Fomin. 1970. Nutr. Abstr. Rev. 40: 793.
21. Ford, J. E. 1962. Brit. J. Nutr. 16: 409.
22. Fragne, R., and J. Adrian. 1967. Ann. Nutr. Aliment. 21: 129.
23. Gorbach, G., and E. Regula. 1964. Fette, Seifen, Anstrichmittel 66: 920.
24. Greaves, E. O., et al. 1938. J. Nutr. 16: 115.
25. Halevy, S., and K. Guggenheim. 1963. Arch. Biochem. Biophys. 44: 211.
26. Hall, W. K., and V. P. Sydenstricker. 1947. Arch. Biochem. 12: 147.
27. Harper, A. E., and M. C. Katayama. 1953. J. Nutr. 49: 261.
28. Harris, R. S., and M. von Loesecke. 1960. Nutritional evaluation of food processing. John Wiley, New York, U.S.A.
29. Hawthorn, J. R., and J. Brooks. 1944. J. Soc. Chem. Ind. 63: 232.
30. Henry, K. M., and S. K. Kon. 1948. J. Dairy Res. 15: 341.
31. Henry, K. M., S. K. Kon and M. B. Watson. 1937. Nat. Inst. for Dairying Report. Pub. No. 37.
32. Hepburn, F. N., et al. 1966. Cereal Chem. 43: 271.
33. Hess, et al. 1952. Naturwissenschaften 39: 135.
34. Hodson, A. Z., and G. M. Krueger. 1947. Arch. Biochem. 12: 51.
35. Jansen, G. R., et al. 1964. Food Tech. Champaign 18: 367, 372.
36. Jones, N. R. 1956. Nature 177: 748.
37. Karandaeva, V. P. 1964. Nutr. Abstr. Rev. 34: 433.
38. Kennedy, T. S. 1965. J. Sci. Food Agr. 16: 433.
39. Klein, et al. 1926. Am J. Physiol. 76: 237.
40. Kon, S. K. 1938. J. Dairy Res. 9: 1.
41. Krehl, W. A., et al. 1946. J. Nutr. 31: 85.
42. Lang. 1970. World Rev. Nutr. Dietet. 12: 267.
43. Laporte, T. and J. Trémoliéres. 1962. C. R. Soc. Biol. 156: 1261.
44. Lea, N. 1958. Fundamental aspects of the dehydration of food. Soc. Chem. Ind. Monograph.
45. Lea, C. H., et al. 1960. Brit. J. Nutr. 14: 91.
46. Lea, C. H., and R. S. Hannan. 1949. Biochem. Biophys. Acta 3: 313.
47. Longenecker, J. B., et al. 1964. J. Agric. Food Chem. 12: 411.
48. Lowry and Thressen. 1950. Arch. Biochem. 25: 148.
49. Mallhi, M., and A. Djazayeri. 1968. J. Sci. Food Agr. 19: 449.
50. Mauron, J., et al. 1955. Arch. Biochem. 59: 439.
51. Mauron, J., et al. 1960. Ann. Nutr. (Par.) 14: 135.
52. Mayfield, H. L., and M. T. Hedrick. 1949. J. Nutr. 37: 487.
53. McBride, B. N., et al. 1951. J. Nutr. 45: 393.
54. Melnick, et al. 1946. Science 103: 326.
55. Miller, D. S. 1956. J. Sci. Food Agr. 7: 337.
56. Miller, D. S. 1970: In: Evaluation of novel protein products. Bender, A. E., R. Kihlberg, B. Lofqvist, and L. Munck (eds.). Pergamon Press, London, England.
57. Milner, C. K., and K. J. Carpenter. 1969. Cereal Chem. 46: 425.
58. Mitchell, H. M. 1935. Nutr. Abstr. Rev. 4: 447.
59. Morgan, A. F. 1931. J. Biol. Chem. 90: 771.
60. Murlin, J. R., E. C. Nasset, and B. E. March. 1938. J. Nutr. 16: 249.
61. Poling, C. E., et al. 1944. J. Nutr. 27: 23.
62. Powrie, W. D., and E. Lambert. 1964.

Food Tech. Champaign 18: 111.

63. Pujol and Gonzalez. 1968. Ann. Bromatol. 20: 149.
64. Regrei, L. W., and A. L. Tappel. 1956. Food Res. 21: 630.
65. Register, V. D., and E. W. Peterson. 1958. J. Nutr. 64: 483.
66. Rose, W. C., M. J. Coon, and G. F. Lambert. 1954. J. Biol. Chem. 210: 331.
67. Rosenberg, H. R., and E. L. Rohdenburg. 1951. J. Nutr. 45: 593.
68. Shyamala, G., and B. M. Kennedy. 1962. J. Am. Dietet. Assoc. 41: 115.
69. Soman and Ambegaokar. 1966. J. Nutr. 38: 117.
70. Stewart, R. A., et al. 1943. J. Nutr. 26: 519.
71. Sure, B. 1951. Food Res. 16: 161.
72. Tarr, H. L. A. 1954. Food Tech. Champaign 8: 15.
73. Tarr, H. L. A., et al. 1954. Poultry Sci. 33: 242.
74. Underwood, J. C., et al. 1959. Food Res. 24: 181.
75. Varela, G., et al. 1963. Ann Bromatol. 15: 117.
76. Wheeler, P., and A. F. Morgan. 1958. J. Nutr. 64: 137.
77. Whitnah, C. H. 1943. Food Res. 8: 89.

PROTEINS FROM MICROALGAE AND MICROFUNGI*

As a means of increasing protein resources, extensive research and development is now taking place on the industrial production of protein from microalgae and fungi. Reports on some of this work were presented to the PAG at its 18th Meeting.

Spirulina

The Institut Français du Pétrole (IFP) research programme on the blue-green algae Spirulina started in 1963. These algae apparently have formed part of the diet of certain tribes of Chad for a very long time and were also reported as being eaten by the Aztecs living around Lake Texcoco near Mexico City. They are rich in protein (70% on a dry basis) which is of a satisfactory quality.

The Spirulina is a "Cyanophyceae" belonging to the family of "Oscillatoriaceae". It is a large-size microscopic (250 microns), multicellular alga whose natural medium is alkaline and rich in sodium bicarbonate. Its requirements for mineral salts are those of all plants, with particular emphasis on sodium, a characteristic of the "Cyanophyceae". The optimum growth temperature lies between 30 and 35 °C while the salinity of the nutrient medium can vary over a wide range. Certain characteristics of the Spirulina which confer considerable advantages over other algae are high protein content (70% on a dry basis), good protein quality, and ease of digestibility. They are large and have a tendency to rise to the surface which simplifies recovery from the culture medium, CO_2 reacts chemically with the alkaline culture medium, with resulting high degree of utilization of CO_2, and the product is easily stored.

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*From background documents presented at the 18th PAG Meeting by:

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The two strains under study are Spirulina platensis, the "Chad strain", and Spirulina maxima, the "Mexican strain". While there are some minor morphological differences between the two strains, no difference in culture behaviour or nutritional behaviour has been noted whether the algae are grown under natural conditions in Chad, artificial conditions by IFP in the laboratory, industrial-type outdoor conditions in France, Algeria and Mexico, or natural/artificial conditions outdoors in the "Caracol" of Sosa Texcoco from the Mexican strain. ("Caracols" are concentration ponds for exploitation of underground brines. In certain parts of these ponds, naturally-occurring Spirulina were found to be growing with occasionally deleterious effects on downstream salt crystallizing operations).

The system of industrial production for the Spirulina comprises (as do all cultures of algae) the following steps: algae culture in production basins, harvesting and washing, and drying and storage. For certain uses, a decolourization step may be included.

A system of natural production similar to that which occurs in the brine lakes of Chad, or a so-called natural/artificial system such as occurs in the "Caracol" of Sosa Texcoco can be envisaged. These may or may not respond to artificial stimulation.

It is necessary to obtain basins with as large a surface as can be economically achieved and in which the culture is subjected to agitation sufficient for the efficient use of light and nutritive elements. It is also necessary to supply the culture medium efficiently with CO_2.

Spirulina are adequately large and can be recovered from the culture medium by filtration in two stages. Washing takes place during the second part of the filtration and enables satisfactory removal of the salts adhering to the Spirulina. Spray drying gives satisfactory results and enables the algae to retain their nutritional qualities. Drying on heated rollers appears to give equally satisfactory results.

Storage presents no problem since the dry Spirulina is not susceptible to fermentation. Decolourization, if necessary, can be done by solvent extraction which results in a product of satisfactory characteristics with a pale fawn color.

The most favourable conditions for production are encountered in the zone located approximately between latitudes 35° north and south of the equator. Within this zone, the best locations are those with a good light intensity without excessive temperature variations, with moderate rainfall and where water of a reasonable quality is available as well as some source of CO_2 (such as natural gas, other hydrocarbons, etc.). Land should be cheap and reasonably flat.

Unitary growth rates can fluctuate throughout the year if light intensity and temperature vary. Under the favourable conditions referred to above, average annual production rates of not less than 12g/m^2/day should be obtainable. All of the culture basins involved in the south of France, then in Mexico and later in Algeria, were at least 5m^2 and those in Mexico 100 and 700m^2. In the optimal climatic conditions of these regions, growth rates of dry algae of 16g/m^2/day have been maintained for over a year. In Algeria, where the culture is virtually dormant during the short winter period, average annual rates of 8g/m^2/day can be maintained throughout the year.

On the basis of the analytical data obtained, Spirulina has a high protein content (64-72%) with a satisfactory essential amino acid content except for a slight deficiency in the sulphur amino acids. It has a high vitamin content, particularly of B_{12}. In studies on rats, the product has been shown to have a digestibility of 84% and a BV of 72. The NPU of the protein was found to be 61 and the PER 2.3 (casein 2.5). The nucleic acid content on a dry basis was 4.1%.

Acute toxicity tests on rats were negative. Subchronic toxicity studies showed that the dried algae up to a level of 10% in the diet of rats did not cause any deleterious effects.

There is need for more biological tests to establish the safety of Spirulina for prolonged human feeding and also appropriate tolerance and nutritional trials in human subjects before the material can be considered safe for human use. The taste of Spirulina is rather neutral, allowing its addition to cereal-type products up to 10% without inducing objectionable off-flavours.

The manufacturing cost of Spirulina is heavily influenced by five factors: the production rate per unit area, the scale of manufacture, the expected life of the polyethylene covering, whether decolourization is necessary or not, and the cost of the land.

On the basis of a unit production rate of 12g/m^2/day, nominal land value and no decolourization, the manufacturing cost is as follows:

Scale, metric tons/year	FF/kg of algae*	FF/kg of protein*
10,000	1.67-1.92	2.38-2.74
1,000	2.30-2.65	3.29-3.79
200	3.39-3.95	4.84-5.64

It was realized that the data available were insufficient to judge probable economic costs. More extensive feasibility studies must be undertaken to justify investments.

Scenedesmus

The Kohlenstoffbiologische Forschungsstation e.V., Dortmund, has been engaged in studies on mass culture of the unicellular green alga Scenedesmus with the object of making a new type of protein food for humans. The basic technology adopted is similar to that applied to the culture of any other microalgae. The substrate, containing urea and the necessary minerals, is stirred continuously using paddle wheels and the algae culture is harvested by centrifugation and dried on a roller drier. The dry Scenedesmus powder has a crude protein content of 50-56% (NPU 50.6 - 70.5; PER 2.7 (casein 3.03)). Animal experiments carried out with rats, chicks and pigs have shown satisfactory evidence of growth. The essential amino acids, which comprise 37% of the total crude protein, are present in satisfactory amounts except for a deficiency of sulphur amino acids. The total nucleic acid content is 3.7% of dry weight. The product is light green with a neutral taste. Toxicological testing on rats up to 8 months showed no adverse effects. No histopathological or long-term toxicological studies have been carried out yet. At the Max-Planck-Institut for Nutritional Physiology, the product has been fed to male human volunteers for a period of five months at up to 80g/day without any adverse effects. The uric acid level did not exceed 800mg/day. It is also reported that patients suffering from conditioned acute protein malnutrition have been treated successfully using diets containing 30-50g of the Scenedesmus powder per day fed through a stomach tube.

Under optimal conditions of production, the wholesale price of the product is estimated to be 27 U.S. cents per kg. It is felt that the data are still insufficient to justify conclusions regarding safety of the material for human use or its potential economic feasibility.

Microfungi

Production of microfungi as a source of protein seems to have many advantages: a better protein profile than single cell organisms (essential amino acids such as methionine and cystine are in adequate concentration, up to 4% of the total protein), easy and inexpensive recovery of the mycelium, by virtue of the filamentous structure, ease of manufacture as texturized foods and acceptability as food. In some parts of the world (Japan, Indonesia and other Asian countries) it is already an ingredient of the daily diet.

At the Lord Rank Research Centre, studies have been in progress for the last few years towards preparation of protein from microfungi.

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*1970 prices.

An encouraging process for continuous cultivation of Fusarium sp. with a generation time of 2 1/2 to 3 hours on a substrate of molasses and starch has been developed. The protein content varies between 45-50% (NPU 70). The product is characterized by high digestibility, with good BV and lysine availability. The raw materials for the substrate are either starch (cassava, potatoes beans, etc.), sucrose (cane juice or molasses or lactose (milk whey). Pilot fermenters for different sizes, both batch and continuous, are working and one 1000-litre fermenter is in continuous operation for runs of hundreds of hours. Using the filamentous structure, beef-, veal- and chicken-like products have been obtained. Fortification of bread and porridges is also believed to be possible without changing the characteristics of the product.

Assuming that the carbohydrate source is molasses to be purchased from the West Indies, Philippines or Mauritius at U.K. £ 5-7 per ton, the cost of production of one ton of protein will be:

Molasses, 4 tons	£ 28
Inorganic nitrogen and nutrients	£ 5
Labor, energy and depreciation	£ 50
	£ 83

Thus one kg of protein fit for human use will cost approximately 20 U.S. cents.

As in the case of algae products, it would be premature to urge investment in the process by developing countries until more information becomes available on reports of biological testing and human acceptability and more data on the economics of production are available.

TEXTURED VEGETABLE PROTEINS*

The chief virtue of the individual members of this new class of foods rests in their ability to supply precisely reproducible balanced dietary inputs of essential amino acids with greatly enhanced agronomic efficiency and with high consumer acceptance. Technologically, they represent fascinating structural vehicles capable of survival intact through standard food processing and end use preparation stresses. When properly fabricated, whether "spun", extruded, extrusion-puffed or otherwise created, their structural matrix of denatured protein permits the incorporation of nonprotein nutrients of essentially unlimited choice range. The net result is a newfound capability of manufacturing, from many commonly available vegetable and other protein sources, new foods which can be designed to fit neatly into any chosen pattern of food preference with any nutritional impact desired.

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*From background documents presented at the 18th PAG meeting by:

1. Dr. F. E. Horan, Archer-Daniels-Midland Co., Decatur, Illinois, U.S.A.
2. Dr. A. D. Odell, General Mills, Minneapolis, Minnesota, U.S.A.
3. Dr. Martin J. Forman, US/AID and Dr. Samuel M. Weisberg, L.I.F.E., Washington, D.C. U.S.A.
4. Swift & Co., Chicago, Illinois, U.S.A.

At the moment, two broad classes of meat analogs are apparent. The extrusion - expansion products sell for US 10-15¢ per pound; the spun monofilament products sell at present in the U.S.A. for 20%-25% less than meats, but are still too expensive to be of interest for developing countries. Other newer, simpler and cheaper methodologies can be expected to emerge as the result of intensive research and development by a large number of corporations currently engaged in this type of activity in several countries.

Spun monofilament products

These are the most elegant and therefore require the most expensive approach. This is a wet process requiring dairy standards of construction and sanitation, high capital investment, complicated equipment, skilled operation and high capacity to be economically competitive and is suited to affluent markets. The precooked, frozen or dry products are extremely versatile and represent a high level of convenience and organoleptic quality. Because of cost, they may be of only marginal interest in developing countries.

Extrusion-expansion products

These consist essentially of full-fat or fat-free oilseed flours, grits, meals or concentrates which have been subjected to short high-energy, temperature and pressure processing. The structure is based on steam-generated voids in a denatured protein lattice. They are usually available in dry forms as flavoured or bland, simple or compound products. This class, and future candidates of this general type, seems most appropriate for the low-income consumer where price is very important. Capital requirements are modest and expertise required is minimal. The products are currently marketed at about 45¢ per pound, which on rehydration gives an end-use price of 10-15¢ per pound. Cost parameters will differ for each country and must be carefully examined in each case.

Since defatted edible-grade soy commodities are readily available as meal and flour at 7-8¢ per pound in the U.S.A., greatest attention has been given to soy. Availability alone has not been the only attraction for soy protein; other important considerations have been those of high functionality and high protein efficiency ratio , the latter of outstanding excellence in its vegetable protein class. Where available, soy is the obvious choice of raw materials.

Although somewhat lower in PER value, solvent-extracted cottonseed protein from the glandless variety or suitable degossypolized standard seed is equally functional and a suitable material for meat analogs can be obtained once improved flour extraction processes are available or glandless varieties come into more universal use. Some supplementation would perhaps be needed to correct for limiting amino acids, either with approved ingredients or by blending with soy flour, fish protein concentrate or various adjuvants.

Peanut protein is even lower on the nutritional quality scale but when flours are prepared by solvent extraction alone rather than by heat-damaging prepressing systems, this too is a suitable raw material. It must be under proper mycotoxin surveillance and corrected for nutritional deficiencies by appropriate supplementation.

Rapeseed is an obvious candidate for raw material in several areas of the world. To date, however, sufficient study has not been directed to the problem of economical edible-grade flour production. This work is now under way in several countries.

The wide availability of wheat prompted the inclusion of this grain in the raw material categories for the Standard of Identity. Properly supplemented, wheat flour protein fractions should be suitable structural materials for meat analogs. Considerable attention is being devoted to this methodology in several laboratories.

General considerations
Meat analogs do not appear to have a negative connotation to vegetarians; there are many examples of eager acceptance of meat analogs by such groups. The textured protein approach is also a stride forward in food efficiency, since conversion of soy protein to animal protein averages about 7% efficiency, whereas texturization of soy to provide meat-like products for direct human consumption is at least ten times as effective. As extenders of meat supplies, either by intimate mixture with raw meats as in sausages, patties, kababs and loaves, or by direct supplementive addition to curries, stews and soups, these products have a most useful role to play in meat-short areas. When used as extenders or supplements, and made isocaloric by vegetable oil inclusion if desired, they also lower the concentration of cholesterol and hard fats without reduction in caloric density.

Where limited meat supply dictates austerity, meat analogs of adequate quality can play a rewarding role as meat substitutes or even help to eliminate such denial by theoretical extension of the meat supply by up to 40%.

The potential for these foods in areas of greatest need is substantial. It would be misleading and uninformative to attempt to place even broad ranges on estimates of future total use. Given a combination of genuine local commitment to improved nutrition and adroit commercial adaptation of expertise, these new foods can have considerable impact on protein-calorie malnutrition.

Case studies
Over the past few years US/AID has entered into contracts with twelve different U.S. commercial companies to investigate and evaluate low-cost proprietary protein products in some ten developing countries.

Thailand. Approximately three years ago the ADM Company received such an industry incentive grant from US/AID to carry out a study of this type in Thailand, focusing interest on textured soy protein products to be used either as supplements or substitutes for meat in the Thai diet. The study comprised three phases.

A marketing study was conducted to obtain information on foods, nutritional deficiencies, consumption habits, and distribution. It showed a diet high in rice (87% of calories, 65% of proteins) and low in animal protein, especially among low income groups in rural areas (15.2 grammes/day). Dietary patterns varied in relation to economic and social status. Also there were great differences between urban and country dwellers. However, the basic foods eaten did not vary to any great extent.

A unique factor in the preparation of meat dishes is that all meats are prepared and served in bite-size portions. No distinction is made on cuts of meats and the desire for bite-size portions lends itself well to usage of textured vegetable proteins in Thai foods.

A product development and application study was undertaken to develop textured vegetable protein-based foods which might be adaptable to local consumption habits and marketing practices. Three products with different constituents were selected for final testing and were tested in the Bangkok area using 150 randomly-selected housewives. The consumers met the products with varying degrees of acceptance. Most of the negative aspects could be corrected by modifying the technology such as further processing, reformulation of ingredients, and by changing the piece size of the TVP. The most positive reaction received was that of the consumer's willingness to try the products and suggest ways by which they could be used and improved. The Bangkok housewives are price-conscious and their interest increased significantly when there were indications that the TVP products could offer substantial savings as compared to the products which they are presently using in their regular diets. One home placement test, such as the one conducted in Bangkok, cannot be all-conclusive and indeed a great amount of follow-up work would yet be required to determine whether these types of products could develop into a commercial reality.

The production of soy in Thailand is at present insufficient to supply raw materials for a TVP industry and a price estimate must be based on imported soy flakes. At a production of 365 tons per year the product could be sold for 64 U. S. cents per pound. When hydrated this comes to 21.3 U. S. cents per pound meat equivalent compared to 40-45 cents for meat.

To assure success, government support is needed in agriculture to promote local soy production, but lower duties, tax concessions, governmental guaranties and interagency cooperation are also necessary.

Brazil. Experience in Brazil (Swift & Co., U. S. A.) has shown that textured meat analogs can be used successfully. However, the comparatively low cost of meat products in countries like Brazil and Argentina reduces the likelihood of these products making a great impact in these countries.

India. Tests have been carried out (Swift & Co., U. S. A.) to determine the acceptance and application areas of textured soy meat analogs in India. The following preliminary observations are made for the Indian market.

It appears that the spun protein fiber type of meat analog will be too expensive for the average Indian family. It is also believed that this approach will have no impact on the protein nutrition of India.

Preliminary experience has shown that textured soy protein made directly from soy flour will have good acceptance in India. It is adaptable to nearly all of their present usage patterns. Observations have shown a good acceptance of this product as a replacement for high-priced meat products.

Economic estimates suggest that textured soy will be priced at approximately 1/4 to 1/6 the cost of Indian meats. Considering the economic advantage of this high protein product, it is believed with a reasonable marketing and educational effort that this development will have a significant impact on the nutritional status of the Indian people.

Texturized vegetable protein products

Some current products and the present status of these products will be described briefly. At this time it is possible to offer only a sampling of these products. The information listed is based on claims of commercial firms.

a) Fibroprotein-Spun Protein Fibers (Worthington Foods Division, Ohio, U. S. A.). The institutional products offered are ground beef-type granules, textured simulated meats, bacon-style chips, dehydrated hamlike nuggets, chicken meat extender, chickenlike cubes and fibroprotein-spun protein fibers. In addition, Worthington produces a large line of retail consumer canned, dried, and frozen items to supply vegetarian and other more or less special dietary needs.

b) Textured "Edi-Pro" (Ralston Purina Company, Missouri, U. S. A.). This product is made from isolated soy protein which is spun as a continuous filament by a patented process. It is stated to have been in commercial production beginning in 1967. On a 50% moisture basis, the moist "tow" was sold in quantity at 45¢/lb. The dried flavoured edible products were offered at $1.53 to $1.70 per lb. It seems evident that these products were designed for food processing and institutional use.

c) "Texgran" Products (Swift & Co., Illinois, U. S. A.) Texturized soy flours are being made under the generic name "Texgran". It is believed that these products belong to the extruded variety since the basic unflavoured product is offered at about 1/3 the price (33¢/lb) of the spun fiber products. The particles cover a wide range of shapes and sizes consisting of granules, cubes and shreds. They are intended for institutional use, as components of hashes and stews, prepared foods and bakery products.

d) "Bontrae" (General Mills, Minnesota, U. S. A.). "Bontrae" is the generic name for a family of spun vegetable protein products. Beef, ham, and diced poultry analogs are being marketed to convenience food manufacturers and institutional purchasers and bacon bits are being retail marketed.

e) Carne Vegetal (Vegetable Meat) (Industria e Comercio de Productos Alimenticios Vegetal, Ltd., Brazil). This product is made from wheat gluten enriched with soy protein isolate and looks like ground meat. It is in small commercial production and is sold in supermarkets and specialty food shops. It is a relatively expensive product.

f) Meat Substitutes and Snack Foods (Hong Kong Soya Bean Products Co., Ltd., Hong Kong). Research and pilot-plant studies on snack foods and meat substitutes from soybeans are being carried out.

g) LiveLong-VP (Nisshin Flour-Milling Co., Ltd., Japan). This product is a wheat gluten extract in the form of a dried or frozen mincemeat-like product; its organoleptic properties are similar to those of meat. It appears to be in full commercial production and sells for the equivalent of 68¢/lb in Japan. It seems to be made by a filament extrusion process using isolated wheat gluten protein.

h) The Farmarco Co. (Kansas, U. S. A.). This company manufactures texturized soy food products for food processors and institutional use; the process used is thermoplastic extrusion.

i) The Fuji Oil Co. (Japan). Manufacture of texturized soy food products by thermoplastic extrusion.

j) Shefa Protein Foods, Ltd. (Israel). The company manufactures texturized soy food products by thermoplastic extrusion.

A few companies in Japan are conducting research and development studies using thermoplastic extrusion equipment with the intention of eventually manufacturing texturized soy foods. Food industry and university research groups are also conducting vegetable protein extrusion processing research and development in Mexico, Thailand, Uganda, South Africa, Taiwan, India, Hong Kong, and Venezuela. It is thus very probable that in due course meat and other protein analogs made by thermoplastic extrusion will become accepted foods in developing countries.

PROTEIN INTAKES, CONSUMPTION PERSPECTIVES AND FACTORS RESPONSIBLE FOR DIETARY INEQUALITIES[*]

by Nutrition Division, FAO

In developing countries, the average protein consumption is generally found to be lower than the level of recommended allowances. Moreover, this gap between consumption and recommended allowances varies according to major ecological zones, countries, and population groups; between urban and rural populations and different socioeconomic groups and within the family unit.

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[*] From a paper submitted for the 18th PAG Meeting, Rome, February 1971.

The average values for protein consumption, as revealed by national balance sheets or by surveys whose results are insufficiently disaggregated, conceal an extraordinarily shifting reality due to human behaviour. They are of no assistance in measuring the protein gap or in formulating programmes on a wholly realistic foundation.

Only national comprehensive surveys of household budgets and consumption can supply, by suitable processing of the information, an exact measurement of the food situation and of protein deficits. Through these surveys the responsible factors can be identified and the necessary remedial measures devised.

On the basis of examples taken from various surveys and data drawn from recent studies (FAO Indicative World Plan), it is planned to list and illustrate the existing and long-term disparities in protein consumption.

The protein situation at different levels of aggregation

In 1970, the opening year of the Second United Nations Development Decade, an examination of the situation of food and agriculture (1) leads to an estimate of overall protein supplies and requirements.

In developed regions, total protein supplies (Figure 1) exceeded requirements by 25 per cent with a tendency towards growth. In the Near East, supplies exceeded those of other developing regions owing to a relatively large consumption of cereals. In Latin America, supplies recently exceeded requirements by 5 per cent. For the Far East, the trend was downwards after a slight advance during the fifties. In Africa, it is believed that overall protein supplies were 10 per cent below the recommended allowances.

Expressed as a percentage of total protein supplies, animal protein supplies (Figure 2) were between 15 and 20 per cent for the Far East, Africa and the Near East, over 35 per cent for Latin America and nearly 45 per cent for the developed regions. None of the different regions considered showed any tendency toward increase in percentage of animal proteins to total protein supply during the last two or three decades.

FIGURE 1. TOTAL PROTEIN SUPPLY, % OF REQUIREMENT BY REGIONS

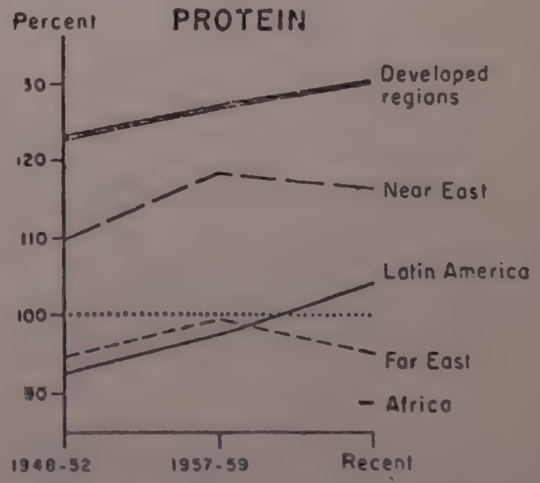
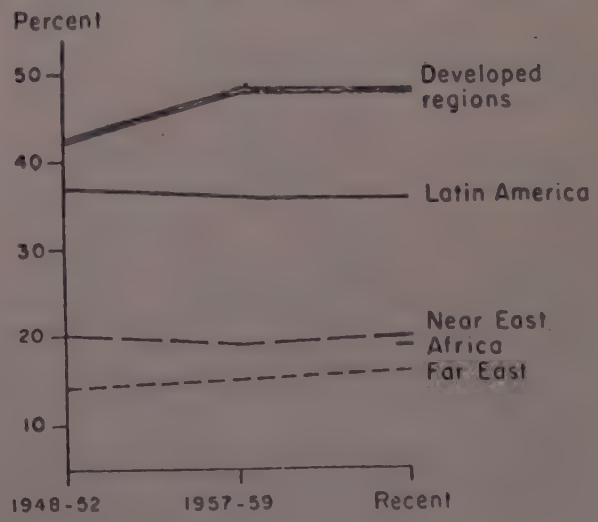


FIGURE 2. ANIMAL PROTEINS, % OF TOTAL PROTEIN SUPPLY BY REGIONS



Apart from Latin America where, only from the point of view of overall supplies (total and animal proteins) the situation appears encouraging at first sight, the gap between developed and developing regions remains large. Moreover, the overall examination of the situation does not take into account the substantial disparities existing between the different countries of a given region. What causes these inequalities in protein distribution? Analysis of food consumption at different levels of aggregation (regions of the world, countries and population groups, households) leads to the identification of two decisive factors: 1) wealth and purchasing power expressed in terms of per capita product or income, and 2) the ecological conditions which dictate the nature of food resources and thus the type of diet and its staple food. There may be a cause and effect relationship between these factors but separating them provides a convenient basis for observation and description.

Protein intake according to income. For most populations with a money economy and those in which money has already made a strong impact on the subsistence economy, the income factor may explain many of the changes in dietary structure and particularly in protein intake.

In a study (2) covering 85 countries with 1880 million inhabitants in 1962, a comparison between the gross domestic product (GDP, an independent variable reflecting per capita income) and intakes of fats, carbohydrates and proteins (total, animal and vegetable) expressed as percentages of total calorie intake showed that when income rises, the proportion of calories supplied by starch falls, while calories from fats and sugar rise. The proportion of calories from total proteins remains constant at about 11 per cent. However, there is an increase in calories from animal protein with a parallel decrease in calories of vegetable origin.

The proportion of protein calories of animal origin, which ranges from 1 to 2.5 per cent in countries with per capita income less than $200, shows a progressive increase with income and almost exceeds 8 per cent in North America. Conversely, the proportion of calories supplied by vegetable protein falls with income, moving from a figure of between 7 and 10 per cent in low-income countries to 3.5 per cent in North America. As a result of this, the proportion of calories supplied by total protein emerges, at the level of aggregation considered, as independent of income.

These observations, if verified in a particular country, will show the same changes in diet structure through the different classes of private consumption expenditure and have a practical value in food planning.

Protein intake according to ecology and diet pattern. The "income" factor only partly explains the disparities between countries and between regions. A comparison of protein intake and recommended allowances as it emerges from the work of the Indicative World Plan shows that populations, still heavily dependent on their ecological environment, are tied to a certain type of diet; the staple food determines the quantitative and qualitative characteristics of the protein ration.

a) Comparison between intakes and recommended allowances.Average protein intake is found to decrease as one examines data from countries which consume large quantities of animal products to countries in the equatorial root and tuber zones. Countries consuming mainly wheat, millet, sorghum, maize, other cereals and rice fall between these two in this order. The inequalities are so marked that the total protein intake in some of the root and tuber zone countries is scarcely higher than the intake of essential amino acids in the industrialized countries. Of the 85 countries considered, 43 representing 900 million inhabitants have protein supplies less than the recommended allowances.

However, whatever the type of diet considered, it is important to stress that within each group (except for the roots and tubers group) there are countries where the average protein intake reaches or even exceeds the recommended level. A detailed analysis of protein sources (3) shows that the recommended allowance of protein is met either by a high intake of animal products; and/or by a higher consumption of pulses (these effectively improve the protein-calorie ratio of the diet in some millet, sorghum and rice countries); or because the protein-calorie ratio of the staple food itself happens to be satisfactory (wheat country). In short, in the absence of efficient supplementation by animal products and pulses, the protein-calorie ratio of the diet is strongly influenced by the staple consumed: wheat - 13.1; sorghum - 10.6; maize - 7.3; rice - 7.1; tubers - between 1 and 7 according to species.

b) Protein quality

The different types of diets are distinguished not only by the relative importance of proteins in the whole diet (protein-calorie ratio) but also by protein quality; this is bound up with the supply of a certain quantity and of a certain proportion of essential amino acids. The last two requirements are reflected in the net dietary protein-calorie ratio (NDp Cal%) and the protein score which is set by the limiting essential amino acid. By bringing together these different indicators in the same table, diets are classified by the nature of the staple food in the same order as already indicated, namely wheat, millet and sorghum, maize, rice, roots and tubers (Table I).

TABLE I. RATING OF DIETS

Type of diet	Protein-calorie ratio	Protein score	Net dietary protein-calorie ratio (NDp Cal%)
Animal products	10.5-13.9	65-68	6.3-7.8
Wheat	11.0-13.3	58-63	6.0-7.0
Millet, sorghum	10.9-14.5	59-63	5.9-7.6
Maize	9.8-12.6	51-62	5.2-6.5
Rice	8.1-12.4	58-65	4.9-6.9
Roots and tubers	6.0-10.2	56-63	3.4-5.6

If the protein characteristics of the countries consuming animal protein (Table I) are taken as a basis of comparison, it is found that the wheat, millet, sorghum and particularly maize-consuming countries have protein deficiency of a qualitative nature (lower protein score); rice diets have good quality protein but show a protein-calorie imbalance; on the other hand, root and tuber diets suffer from a protein handicap caused both by the structural imbalance and by the poor quality of its proteins.

In the establishment of programmes to improve the protein quality of diets either by conventional means (supplementation with suitable foods) or by artificial methods (addition of synthetic amino acids), it is advisable to consider the essential amino acid as the limiting factor. However, the limitations indicated for the different food patterns are based on average intakes and are valid only in a general way for a particular group of countries. What must be examined before anything else is the level of supplementation by animal products and pulses attained by each country and within each country by the various socioeconomic strata. This level governs both the chemical score of the diet and the nature of the limiting amino acid(s).

Inequalities in protein intake between regions and between countries are both quantitative and qualitative and appropriate action may be taken either by improving the protein-calorie balance or by supplying in some way the amino acids necessary to raise the protein quality of diets. Here again, food consumption surveys at the national level are expected to provide necessary information, especially in regard to amino acid intakes.

Inequalities of distribution within populations.

Most of the data examined so far are based on national averages as derived from good balance sheets. However, the balance sheets do not cover the way in which food resources are distributed within a particular country among the various population groups. The result is that national supplies whose level is around that of requirements may give the impression that the food situation is satisfactory whereas serious protein deficits may in fact exist.

The patterns of distribution of food or nutrient intakes around the averages can be studied only on the basis of results of national surveys of household budget and consumption. The purpose of these is to estimate the number of underfed households or persons on a rational statistical basis. Survey reports containing such information are still very few, and especially so with regard to protein intake distribution.

As a general rule, analysis of the distribution curves shows that when the food supplies of a population fall, consumption inequalities worsen and the number of underfed families simultaneously increases, more than proportionately to the movement of the average; at the same time, the frequency curves change their shape in accordance with a right skewed distribution characteristic of developing regions where protein intakes are low.

a) Influence of urbanization

The influence of cash income on consumption of animal protein was discussed earlier. If urbanization has gone beyond certain critical stages, has been effected smoothly and brings with it a noticeable improvement in employment, purchasing power, market possibilities and living conditions, it should certainly have the same effect as cash income with regard to the quantitative and qualitative improvement of the protein ration. For example, in studies carried out in Tunisia, the animal protein intake of populations of large cities was found to be nearly twice as great as that of rural populations. However, among the latter, isolated and scattered populations showed a better coverage of requirements than populations grouped together in communities.

On the other hand, urbanization and conversion to a money economy, in their initial incomplete and temporary stages, will act as disturbing influences in societies hitherto stable and adapted to their ecological context. The transition to a market economy will gradually turn households away from their subsistence activities and, in regard to nutrition, will cause them to lose more than they can offset by their monetary gains. Expenditure will be directed towards prestige products which are not necessarily conducive to good nutrition; urbanization and conversion to a money economy will in that case be unaccompanied by any improvement in the protein ration and sometimes indeed will play a negative role at the expense of the vulnerable groups.

b) Influence of market constraints

Consumption of total and animal protein is considerably influenced by market possibilities. These depend simultaneously on purely ecological factors, cultural potential, season and on the organization of distribution channels. With regard to the last, in rural areas one of the major constraints is access to the village or the condition of roads and paths, and their effect on protein consumption may be positive or negative.

Food consumption and protein intake are strongly influenced, particularly in rural areas, by differences in the size of harvests from one year to another; storage capacity (in some countries, especially in Africa, the scarcity of food between harvests is a crucial problem for populations, as evidenced by several surveys); the proportion of food produced and consumed at home and of purchases; the distance to sources of fish (rivers, lakes, coasts); and price fluctuations.

When it is possible to do so, budget-consumption surveys may bring to light these various factors and thus furnish useful data for a marketing policy.

c) Influence of family size and composition

Are people better fed when they belong to a small family or to a large family? Several survey reports indicate that the quantity and quality of food are closely dependent on the size and composition of the consumption household; that is, on the group of persons making joint use of food or budgetary resources. In general, intakes of calories from total and animal protein are inversely proportional to the size of the family, all other things being equal. Variations in protein intake with family size can be expressed correctly only if account is taken of the variations in requirements from one family to another, variations, due to infinite combinations, between individuals of different ages and sex and with different requirements. Large households are usually those containing the most children. When poverty necessitates a low per capita protein consumption, sharing within the family becomes inequitable and occurs at the expense of the vulnerable groups, especially children of preschool age. It may be that the coverage of the protein requirements alone of children from one to five years old is below that of adults or there may occur both protein and calorie deficits in children.

It is plain that, in many cases and whatever the average consumption levels, adults cover their calorie and protein requirements at the expense of children. This may be explained by a tendency for children to eat more slowly when they take from the common plate. Such deficits noted during consumption surveys largely explain the retarded growth and signs of protein malnutrition observed during clinical investigations. Although little information is available on this subject, the diet of pregnant women and nursing mothers within the family group does not appear to be qualitatively better than that of other consumers.

References
1. FAO. 1970. The state of food and agriculture. Food and Agriculture Organization of the United Nations, Rome, Italy.
2. Perissé, J., F. Sizaret and P. François. 1969. The effect of income on the structure of the diet. FAO Nutrition Newsletter No. 3, July-September.
3. FAO. 1969. Consumption and nutrition perspectives and food policies. Provisional Indicative World Plan for Agricultural Development, Vol. 2, Chapter XIII. NU: MISC/69/32.

Cambridge, Massachusetts, U.S.A.

INTERNATIONAL CONFERENCE ON NUTRITION, NATIONAL DEVELOPMENT AND PLANNING

The conference was held at the Massachusetts Institute of Technology, Cambridge, 19-21 October 1971. Fifty-five countries were represented in an important pioneering dialogue, an interchange of views and experience between development planners and nutritionists. The main objective of the conference was the question whether nutrition should logically receive major emphasis in national development plans all over the world, especially in the lower income countries of the Third World, for economic as well as for humanitarian reasons, bearing in mind the other very great claims on limited resources of all types. This is a question of the greatest importance, affecting the well-being of millions of people.

The discussion topics of the conference included:
1. Interaction of nutrition and economic development
2. Goals: conflict into confluence
3. Wider roles and systematic approaches

The biological impact of nutrition has been amply stated, both its immediate effects and its long-term effects (physical and mental). Nutrition, however, is not the only part of the complete ecology and we must consider all the different interacting variables in development plans. In recent years nutritionists have come to realize more and more that their role is much wider than previously imagined. They have become aware of their wider responsibilities considering the impingement of all aspects of ecology on nutrition, including the economic level of the community, the financial burdens of malnutrition on the community and the need to consider cost-benefit implications of alternative programmes.

The economic consequences of nutritional status, and malnutrition in particular, have also been emphasized, including the cost of malnutrition, the educational loss and the productivity of the worker. Two different ways of approaching development plans have been tried over the years. One, with major emphasis on national economic expansion, rising Gross National Product (GNP), capital production and so forth, was based on the assumption that a rise in GNP would give the population more general benefits, including nutritional improvement; this has not come about as was hoped. The second development was related more to standards of living rather than interpretation in exclusively economic terms. The planner tries to reach both an increase in the GNP and a greater concern for social benefits. This change seems to have come about partly for humanitarian reasons and partly as a way of reaching the people in the community directly and seems to be a much more positive approach.

In the last two decades, nutritionists and planners have often been in conflict but a lot of their problems are shared. In now seems logical and necessary that the goals and objectives, the aims and actions of the development planners and the nutritionists come together. The planner is certainly concerned with the improvement of human resources, with the quality of life and social benefits and he realizes that his decisions can affect nutrition. On the other hand, the nutritionist has appreciated more and more the cost-benefit realities of his work.

This mutual reexamination is leading to a changing and widening of the roles of these two groups and in turn to a more systematic approach to the whole question of nutrition planning.

Although the level of accurate information is still imperfect, there is sufficient already available to move ahead jointly into new types of programmes, such as the idea of relating the degree of investment in a national development budget to the amount of serious malnutrition. There is also the desirability of collecting information leading to an "econutritional profile", a new conceptual approach merging the nutritional with the planning approach.

This trend becomes more and more visible in international agencies such as WHO, PAHO, FAO, and UNICEF where emphasis on nutrition in national planning has key priority and planners at an international level are concentrating on a mixed or balanced approach to development emphasizing both economic advancement and social benefit. It is also evident in some individual countries, notably India and Sweden, and a variety of other organizations and institutions and it is hoped that this trend will receive more and more support.

DBJ

Instanbul, Turkey

FAO/SIDA INTER - REGIONAL SEMINAR ON FOOD PROMOTION

This seminar, held in Instanbul, Turkey on 4-13 October 1971, was organized by the Nutrition Division of FAO, with financial support from the Swedish International Development Authority, and was hosted by the Government of Turkey.

The seminar was convened primarily to strengthen the efforts of selected personnel from developing countries in planning and implementing promotion campaigns for nutritionally beneficial foods, especially new, processed protein-rich foods. Subsidiary objectives were: 1) to explore the relevance of product promotion practices in developing countries to the marketing systems and environment of developing countries, especially those of Africa and the Near East, 2) to evaluate different experiences in applying techniques of consumer research, media planning, campaign organization, and advertising design to problems of food marketing and 3) to recommend ways and means of promoting new foods in harmony with the economic, social and nutritional objectives of developing countries.

The seminar was conducted in English, and was attended by 31 representatives from U.A.R., Ethiopia, Ghana, Iran, Jordan, Kenya, Nigeria, Sierra Leone, Sudan, Syrian Arab Republic, Tanzania, Turkey and Uganda. Participants were drawn from different sectors of government, including Ministries of Agriculture, Health, Economic Planning, Commerce and Industry and from food manufacturing enterprises, both public and private. The meeting benefited considerably from this multidisciplinary participation.

Lectures and presentations were made by both international and Turkish experts in the relevant fields of food marketing, economics, consumer research, advertising and nutrition, in addition to FAO staff from Rome and regional offices concerned with protein food development. UNICEF and WHO participated as observers.

The seminar programme was designed to reduce to a minimum procedural and general discussion, and to maximize opportunities for review of problems in specific subject areas. These include: Marketing New Foods, Food Habits and Consumer Behaviour, Consumer Protection, Research Techniques for Promotion Planning, Planning a Promotion Programme, the Use of Communications Media, Campaign Implementation, and the Protein Marketing Problem. One day was devoted to individual country presentations, a half-day to current case histories of protein food marketing from Near East, African and Latin American experience, and a whole day to regional Working Group discussions and reports. Field visits were arranged to the newly-installed infant food processing plant in Istanbul supported by FAO/WHO/UNICEF assistance, to the touring product demonstration van used in the promotion campaign for the protein-rich infant food Sekmama launched this month , and to food retailers.

The final plenary session approved 15 recommendations covering technical procedures for food promotion, guidelines for marketing new protein-rich foods, and proposals for follow-up by FAO. These recommendations included requests that 1) FAO should take the leadership in establishing procedures for regular interchange of documentary information on protein food promotion between government and industry specialists currently active in this sphere, and 2) FAO should convene follow-up seminars, workshops and training courses, on a national or subregional basis, on protein food marketing and promotion.

A report on the proceedings of the seminar will be issued shortly by FAO. Copies of papers presented may be obtained on application to the Nutrition Division, FAO, Via delle Terme di Caracalla, 00100 Roma.

NAW

Uppsala, Sweden and Addis Ababa, Ethiopia

DAG HAMMERSKJÖLD SEMINAR ON NUTRITION AS A PRIORITY IN AFRICAN DEVELOPMENT

The seminar was held, 19-27 July 1971, at the headquarters of the Dag Hammerskjöld Foundation on the campus of the University of Uppsala. The headquarters is a modest but comfortable former residence about 250 years old which Mr. Hammarskjöld admired from the days when he passed it every day on the way to and from school. It is not far from the castle where he lived, his father being district governor.

The Foundation, established in 1962, has been principally engaged in providing training of a specialized nature for nationals of developing countries, mainly civil servants. Several seminars have been held by the Foundation in Africa and Europe and most of these were concerned with various aspects of the problems of African development. In the present seminar, the Foundation took up for consideration for the first time, the important but complex role which nutrition plays in National Planning and the seminar was entitled "Nutrition as a National Priority in African Development".

The participants included senior officials and representatives from the Ministries of Agriculture, Health, Education, Planning and Finance from nine English-speaking countries of Africa. Representatives from international organizations and technical bilateral agencies also participated. Following the sessions in Uppsala, the participants moved to Ethiopia for two days of observations and discussion. In Ethiopia, the discussions were held in the Foundation's own centre in the city of Addis Ababa.

The main purpose of the seminar was to bring about a "confrontation" between economists and planners of developing countries and nutrition programme advocates. The opening statement by Mr. Michanek, Director-General, SIDA, made a strong plea for strengthening the role of nutrition in the technical assistance programme during the current decade. He made a clear and forceful statement recommending action to improve nutrition of young children to meet their basic human right as well as to support social and economic development. The economists and planners emphasized the need for information on cost benefits of nutrition programmes as well as feasibility of carrying out such programmes before the case is presented for resources. There were suggestions for including nutrition in national training programmes for administrators. Such training activities could provide practical planning exercises in food and nutrition policy under different hypothetical situations. The important role the communications experts could play in nutrition education programmes was brought out by a few speakers. Some of the other topics which received detailed consideration were agricultural planning and production, food processing, conservation and distribution and nutrition planning in public health. Professor Ohlin, who was a member of the United Nations Secretary-General's high-level Panel on Protein Strategy in May, 1971, summed up the Uppsala discussions with a presentation on "An overall strategy of assistance in the field of nutrition".

At the Addis Ababa session, the participants were provided field demonstrations to show the different types of malnutrition, the socio-economic and other factors responsible for them and their consequences. It was possible for the seminar to bring home the point that nutritional improvement is an essential part of national development and any progress in this area requires the active and sympathetic collaboration of a variety of experts in different fields and of government administrators and planners. The seminar can be regarded as one additional step toward planning and implementation of national food and nutrition policies in Africa.

Miami Beach, Florida, U.S.A.

THIRD WESTERN HEMISPHERE NUTRITION CONGRESS

This triennial international conference for nutrition scientists and related disciplines of the Americas was held in Bal Harbour (Miami Beach), Florida, from 30 August to 2 September 1971. It was organized by the American Institute of Nutrition and the Council on Food and Nutrition of the American Medical Association, in cooperation with La Sociedad Latino-americana de Nutricion (SLAN) and the Nutrition Society of Canada.

A session on alternative strategies for meeting protein needs included a report on the status of genetic improvement of food crops, the prospects for meeting protein needs from conventional foods, and the use of unconventional resources such as amino acid fortification, single cell protein and fish protein concentrate. Other sessions reviewed current knowledge in vitamin A requirements, growth and development, the nutritional status of children and malnutrition and infection. Attention was given in other sessions to the control of nutritional quality of traditional and novel fabricated foods, education in nutrition and the relationship of food production to pollution of the environment.

Proceedings of the meeting will be published and may be obtained by writing to Dr. Philip L. White, American Medical Association, 535 N. Dearborn St., Chicago, Ill. 60610, U.S.A.

Ste. Adèle, Québec, Canada

INTERNATIONAL CONFERENCE ON THE SCIENCE, TECHNOLOGY AND MARKETING OF RAPESEED AND RAPESEED PRODUCTS

This conference was held in Québec, Canada, on September 20-23, 1970. The proceedings, published by the Rapeseed Association of Canada, contain the papers presented at the conference which was attended by nearly four hundred scientists, technologists and businessmen from twenty nations. The official conference statement is reproduced below.

"Rapeseed has long been a major source of edible oil, and accounts for about 8% of the world's total vegetable oil supplies. This important oilseed and its end products of oil and meal have been the focal point of discussions by scientists, traders and processors from 20 countries gathered in Canada at Ste. Adèle, Québec, for the International Conference on the Science, Technology and Marketing of Rapeseed and Rapeseed Products, September 20-23, 1970.

"One of the Sessions drawing considerable attention concerned results of nutritional research on experimental animals fed large quantities of rapeseed oil containing high levels of erucic acid. It was found that such high erucic acid oils cause changes in heart tissue of some of these animals. The levels of rapeseed oil fed to these experimental animals were, however, substantially higher than those attained in the human diet. No hazard to human health has been attributed to rapeseed oil now or throughout its long history as a staple component of the human diet.

"Plant breeders reported that new rapeseed varieties low in erucic acid and higher in linoleic acid, have been developed in several countries. Seed stocks of such varieties have been increased. A gradual change-over to these new varieties will be possible in many rapeseed-growing countries during the next few years. During this transition period the regular rapeseed oil now available will continue to be used. The physical and nutritional properties of oil from these new low erucic acid varieties were reported to be desirable.

"The anticipated change-over to low erucic acid rapeseed oil is consistent with the preliminary scientific results presented at the Conference. It is in accord with the August 12th statement of Canada's Minister of National Health and Welfare who stated that Canada considered it prudent to recommend a phasing in of the new low erucic acid rapeseed varieties."

Papers dealing with processes for refining protein products from rapeseed were also presented at the Conference. Certain characteristics of the rapeseed, namely its content of goitrogenic and growth inhibitory factors and the high fiber content of the non-oil fraction, makes it difficult to apply the same technology to rapeseeds. However, the Food Research Institute, Canada Department of Agriculture, has developed a process to remove the disadvantageous components. Briefly, this process consists of wet heat inactivation of the enzyme myrosinase, followed by an aqueous extraction to remove the thioglucosides. The dried meat and seed coat mixture is then solvent-extracted to remove the oil and the defatted material is air-classified into the meat fraction (rapeseed flour) and the seed coat fraction (rapeseed meal). The edible flour contains 55% protein and 7-9% fiber. It was found that rapeseed protein, as it exists in thioglucoside-free and solvent-extracted, high-protein flour or hull-rich meal, is of good nutritional quality. Although more detailed studies are planned to thoroughly assess the nutritional value, the results suggested that rapeseed protein has a high potential as a protein source in human food formulations. In such an application the flour, because of its low fibre content, has definite advantages over the meal.

Addis Ababa, Ethiopia

TRAVELLING SEMINAR ON PROTEIN FOODS IN AFRICA ORGANIZED BY FAO AND WHO

A travelling seminar on protein problems with particular reference to weaning foods was organized jointly by the Food and Agriculture (FAO) and the World Health Organization (WHO) in Addis Ababa from 23 to 25 September 1971.

Participants in the seminar included officials of Ministries of Health and representatives of food industries from Cameroon, Republic of Zaire, Ethiopia, Ivory Coast, Kenya, Madagascar, Nigeria, Sudan and Zambia.

The purpose of the seminar was to promote the concept of the development of local weaning foods in African countries and also to demonstrate how this could be implemented with the assistance of FAO, WHO and the United Nations Children's Fund (UNICEF).

The subjects discussed in the seminar included the problem of protein-calorie malnutrition and factors contributing to its high prevalence; the place of weaning food mixtures in programmes of prevention of protein-calorie malnutrition; guidelines for the formulation of protein-rich mixtures for use as weaning foods; preclinical and clinical testing; and the story of "faffa", its commercialization and marketing. Visits were also arranged to production plants and distribution channels for faffa.

The participants moved to Algiers on 26 September, where the seminar continued from 27 to 29 September. The participants had an opportunity to see the production, distribution, marketing and use of "superamine", a processed weaning food.

The participants recognized that the protein-calorie malnutrition prevailing in their countries was a serious problem calling for immediate action. There was a strong feeling among participants that low-cost protein infant food production would be feasible in many of the countries represented at the seminar, but in the initial stage such production should preferably be on a scale smaller than that of Algeria. A number of obstacles with regard to marketing were recognized, which call for assistance from marketing experts.

The participants, many of whom intended to draw their governments' attention to possible ways of alleviating malnutrition among infants, discussed during the seminar, realized that the United Nations Agencies concerned would be able to provide assistance in the field of protein food production and marketing.

The conclusions made in the seminar will provide guidelines to African Governments in their effort to solve nutritional problems during the weaning period.

Columbia, Maryland, U. S. A.

CONFERENCE ON THE USE OF GROWTH CHARTS FOR ASSESSING PROGRESS OF CHILDREN AND TEACHING OF PARENTS

This conference was held at the Urban Life Centre, Columbia, May 10-12, 1971.

The conference was sponsored by the Office of Nutrition, Technical Assistance Bureau, US/AID and the Maternal and Child Health Service of the Department of Health, Education and Welfare, U. S. A. The objectives of the conference were to review the experiences in the use of growth charts, to suggest improvements and to plan the evaluation of their effectiveness as a programme tool in improving the health and nutrition of the young child. Of the 33 participants, 24 were from the U. S. A., two from Africa, two from Asia, three from Latin America and the Caribbean and two from Europe. A preliminary report giving a brief summary and important recommendations has been issued.

MALNUTRITION AND DEVELOPMENT

The following is quoted from part of an address by Robert S. McNamara, President of the World Bank Group, to the Board of Governors. The address was given in September, 1971, in Washington, D.C., U.S.A.

"Much of the most significant knowledge dealing with nutritional deficiencies -- and most particularly the implications for development -- has been discovered only recently. Even now the full extent of these deficiencies in the less-advantaged countries and the degree to which they seriously limit economic and social progress is only beginning to become apparent. And we have hardly even begun to develop plans to deal with the problem.

"The argument I shall make is that:

Malnutrition is widespread.
It is a major cause of high mortality among young children.
It limits the physical -- and often the mental -- growth of hundreds of millions of those who survive.
It reduces their productivity as adults.
It is therefore a major barrier to human development.

And yet, despite the evidence that with a relatively small per capita expenditure of resources major gains can be achieved, there is scarcely a country in the developing world where a concerted attack on the problem is underway.

"The number of childhood deaths is enormous in the poorer countries. Malnourishment severely lowers immunity to infection, and tens of millions of children succumb each year to preventable fatalities simply because they have no reserves of resistance. The Food and Agricultural Organization states that 'malnutrition is the biggest single contributor to child mortality in the developing countries'. And that contention is borne out by the Pan American Health Organization's reports of studies in Latin America which show malnutrition to be either the primary cause, or a major contributing factor, in 50 to 75% of the deaths of one- to four-year-olds.

"How great is child mortality in the developing world?

In India, there are large areas where deaths in the first year of life number as many as 150 to 200 per 1000 live births.
In the United Arab Republic, the proportion of children between the ages of one and two who die is more than 100 times higher than in Sweden.
In Cameroon, children under five, although only one-sixth of the population, account for one-half of the deaths.
In Pakistan, the percentage of children between the ages of one and four who die is 40 times higher than in Japan.

"Clearly, the first result of widespread malnutrition is high child mortality.* But not all malnourished children die. Hundreds of millions of those who live -- and the FAO and WHO estimate that as many as two-thirds of all surviving children in the less-developed countries have been malnourished -- suffer serious deprivation of the opportunity to realize their full human potential.

"The deprivation often begins before the child is born. In the last three months of pregnancy, and the first two years after birth, a child's brain reaches nearly 90% of its structural development. During this critical period, a deficit of protein can impair the brain's growth. Autopsies have revealed that young children who die of protein-calorie malnutrition may have less than half the number of brain cells of adequately nourished children in the same age group.

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*It is becoming clear that the population problem and the nutrition problem are closely intertwined. In the end better nutrition will have a beneficial effect on reducing fertility, despite the short-run reduction in infant mortality. Indeed, many authorities believe that reduced infant and child mortality are preconditions for successful population control.

"While it is difficult to distinguish the effects of protein deficiency on child development from other aspects of poverty in the child's environment, there can be no serious doubt that there is a relationship between severe malnutrition in infancy and mental retardation -- mental retardation which more and more scientists are concluding is irreversible.

"But malnutrition attacks not only the mind but the body as well. Protein deficiency seriously limits physical growth. The Director of the National Institute of Nutrition in India reports that 80% of the nation's children suffer from 'malnutrition dwarfism.' Low-income populations almost universally have a smaller body size. The FAO estimates that more than 30 million children from these groups suffer 'grossly retarded physical growth.'

"Prolonged into adulthood, the poor mental and physical growth characteristics of the early years can greatly impair the range of human capacities. Add to that the current low standards of nutrition for grown adults in much of the developing world, and it is clear why there are adverse effects on the ability to work. Workers who are easily fatigued and have low resistance to chronic illness not only are inefficient, but add substantially to the accident rate, absenteeism, and unnecessary medical expenditure. More serious still, to the extent that their mental capacity has been impaired by malnutrition in childhood, their ability to perform technical tasks is reduced. Dexterity, alertness, initiative: these are the qualities that malnutrition attacks and diminishes.

"We are not speaking here of dietetic nuances, or the fancies of food faddists. We are speaking, instead, of basic nutritional deficiencies which affect the minds and bodies of human beings. But the problem is so dimly perceived, so readily dismissed under the pressure of other priorities that we have neither applied the knowledge now at hand, nor mobilized the resources required to broaden that knowledge further.

"In one sense, of course, the ultimate cause of malnutrition is poverty. But this does not mean that we either must, or can even afford, to wait for full economic development to take place before we begin to attack the problem. On the contrary, reducing the ravages of serious malnutrition will itself accelerate economic development and thus contribute to the amelioration of poverty. And there are a number of practical steps which can be taken even within the limitations of our current knowledge and economic priorities.

"As in the case of the population problem, the nutrition problem represents less a need for new and immense amounts of development capital, than a need for realistic understanding of the situation. What we already know suggests that to meet basic nutritional deficiencies of hundreds of millions of the developing peoples will not entail unacceptable costs. It has been estimated, for example, that at a cost of $8 per child per year one could make up the deficiencies of a diet that now deprives him of one-fourth of his caloric need.

"There are, in fact, many promising possibilities for increasing the nutritional value of food through low-cost agricultural and industrial solutions:

> Crop shifts -- through appropriate pricing policies -- from low-protein cereals to high-protein pulses.
> The introduction of higher nutritive strains of conventional cereals, such as the new high-lysine corn which doubles protein value.
> The fortification of existing basic foods to improve their nutritional value, such as the protein fortification of cereals, and the vitamin and iron fortification of wheat flour.
> The development and distribution of wholly new low-cost processed foods, particularly for the feeding of young children, using available oilseed protein.

"There are, of course, many other solutions -- some already available, some near at hand on the research horizon -- which deserve support. But the central conclusion I wish to propose to you is that the international development community and the individual governments of the countries concerned must face up to the importance and implications of the nutrition problem."

A STUDY ON PROTEIN CONTENTS OF YAMS*

At the Federal Experiment Station, Mayaguez, Puerto Rico, total nitrogen determinations on tubers of 40 yam varieties revealed a protein content varying from 6.3 to 13.4 per cent. This compares favourably with reports of 1-6 per cent in cassava, 4-6 per cent in sweet potato, and 3-5 per cent in taro.

It is significant to find that yams (tubers of species of Dioscorea) contain approximately twice the per cent protein of taros and sweet potatoes, and probably 3-4 more times the protein of the most common substitute for yams, cassava. Tests of 40 cultivars were distributed among 5 species as follows: D. alata, 28; D. esculenta, 6; D. bulbifera, 3; D. rotundata, 2; and D. trifida, 1. Differences among averages for the species were no greater than differences among the cultivars. Seven varieties contained 10 per cent protein or more, and 4 contained between 9 and 10 per cent. Average protein was 8.5 per cent. High protein occurred most commonly in yams with compact flesh and high starch content, but high protein was apparently not associated with 98 other characteristics of the yams that were measured or observed. Varieties of yams with smaller than normal (for the variety) or immature tubers were among the lowest in protein content. In addition to its nutritional value, the high protein of yams affects cooking characteristics, taste, and processing qualities.

Further studies are in progress to determine the amino acid content of the different varieties of yams.

IMPROVED TECHNIQUES FOR PULSE MILLING**

The pulse milling industry has a vital place in the Indian food economy. India produces about 12,000,000 tons of pulses per year. If an average increase of 10% can be effected in processing yield, approximately another 1,000,000 tons of dhal would become available for human consumption. As high-yielding varieties of pulses have not been produced as yet, it is all the more necessary to prevent processing losses.

The new and simple process of milling pulses developed at the Central Food Technological Research Institute, Mysore, gives a higher yield, by about 10%, than the conventional methods. It is completely independent of climatic conditions, and has other advantages such as better quality of the end-product, smaller investment, and savings in time, space, labour and processing costs.

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* Further details regarding this work may be obtained from Drs. F. W. Martin and A. E. Thompson, USDA, ARS, Crops Research Division, at the above address in Puerto Rico.

** From a report by the Central Food Technological Research Institute, Mysore, India, 1971.

The current practices in dhal mills in India vary widely from place to place. However, all of them consist of two essential steps, a) loosening of the husk by sundrying and b) removal of the husk by suitable machines, followed by splitting.

Prolonged drying of the pulse in the sun is an important step as it determines the extent of removal of husk. In both the dry (large-scale) method and the wet (small-scale) method this step is completely dependent on good sunshine; even under the best of conditions, 2 to 5 days are required to dry the grains adequately. In the rainy season, or in winter, this method of drying is ineffective, and some pulses which require good drying are processed with great difficulty. The milling characteristics of inadequately dried pulses are poor and lead to great losses. Moreover, the time taken to process one batch may be a week or more.

Removal of the husk and splitting is usually accomplished by power-driven chakkis (grindstones) or by roller machines. Chakkis crush the grains and produce a large amount of brokens, while rollers scour the surface of the grain and cause powdering. The inefficiency of the machines becomes more patent when the grains are not properly sundried. Under unfavourable drying conditions, the grains may have to pass through the rollers as many as 12 to 16 times in order to remove the husk completely; as a result, losses are very high. Even under the best climatic conditions, a good quality of thur pulse gives a dhal yield of only 72-74%, which is 12-14% less than what could be obtained if there were no losses.

The new method of pulse milling developed by the CFTRI also consists of two stages. First, a new conditioning technique, employing specially designed conditioning units. loosens the husk and makes it friable. This technique does not rely on sunshine at all, and can be used by day or night throughout the year. The seasonal, varietal, and regional variations in the raw material which are known to interfere in the conventional practice of milling do not exert any influence when this method is adopted.

In the second stage, removal of the huskis effected by a specially designed pulse dehusking machine which can completely dehusk the grains in a single pass if the grains are properly conditioned. Most of the grains (60-65%) are obtained as dehusked whole pulse or "pearled" pulse, while the rest (20-25%) are obtained as dehusked split dhal. The total yield obtained in the laboratory averages between 85 and 87%, which is 10-12% more than the conventional yields.

Finally, if desired, the dehusked whole pulse can be split and converted to dhal, without any appreciable breakage, by machines and methods developed for this purpose.

The average yield of dhal is greater by 10%, and the time of processing is reduced to about one-third. If the new method is applied on a commercial scale, the cost of processing is expected to be substantially less.

INTERNATIONAL AFLATOXIN CHECK SAMPLE PROGRAMME

At a meeting held on February 9, 1971 in Washington, D. C., U. S. A., a voluntary committee consisting of the following members was appointed to plan and organize an aflatoxin check sample programme on a global basis.

Dr. Francis B. Coon (Chairman), WARF Institute, Inc., Madison, Wisconsin, U. S. A.

Dr. Fred Bauer, Proctor & Gamble Co., Cincinnati, Ohio, U. S. A.

Dr. L. R. L. Symmes, Canada Packers Ltd., Toronto, Ontario, Canada.

During the following three weeks, this committee, called the International Aflatoxin Check Sample Committee, contacted a large number of persons and organizations around the world to obtain samples of commercial peanut meal, de-oiled peanut meal prepared in the laboratory, butter made from raw peanuts and butter made from roasted peanuts for exchange and testing. Beginning in May, 1971, 100 sets of four samples each were mailed out to participating laboratories through the help of Dr. John Wegener of USDA. As of July 15, 154 laboratories have received the samples and another 56 have expressed interest in the programme. The results of the analysis will become available shortly.

The committee is hopeful that permanent machinery can be established so that an ongoing programme may be developed for those who need it. Although the first set of samples was provided gratis, it is proposed to cover the cost for future check sample sets in the form of a fee. Persons interested in any part of the programme may contact any one of the present committee by letter.

IMPROVEMENT OF THE PROTEIN CONTENT OF RICE

An intensive screening programme at the International Rice Research Institute has identified high protein semidwarf lines which have 14 to 36 per cent higher protein content than IR8 but 1 to 34 per cent lower yield. Two of these had about 20% higher mean protein content than IR8 and only about 5% lower yield during tests in the 1971 dry season. Work on new crosses is in progress, combining parents with increased resistance to disease and insects, high yield, improved grain type and eating quality. Lysine screening of 10,493 entries from world collections and detailed aminogram of 38 selected entries showed an improvement in lysine content by 0.5 percentage point.

Tests with human subjects and albino rats have shown favourable results.

Reference

Fourth Annual Report May 10, 1970 to May 9, 1971 and Progress Report May 10, 1971 to Sept. 9, 1971. The International Rice Research Institute, Los Baños, Laguna, The Philippines.

Y. Pomeranz, ed.:

WHEAT : CHEMISTRY AND TECHNOLOGY

The present volume, the third in the monograph series sponsored by the American Association of Cereal Chemists, is a review of the present state of knowledge in wheat chemistry and technology. The first edition appeared in 1964 and the present one includes developments and advances in the last decade. It is a multi-author work with contributions from 25 authors of which five are from outside the U.S.A. The book is divided into five parts containing 15 chapters. There are chapters on production and use of wheat, criteria of quality, structure and composition of kernel, milling principles, flour quality, proteins, carbohydrates, lipids, enzymes and pigments of wheat, rheology and chemistry of dough, functionality of wheat flour components, bread making, soft wheat products and durum wheat and paste products.

Pomeranz, Y. (ed.). 1971. Wheat: chemistry and technology. 2nd. ed. American Association of Cereal Chemists, Inc., St. Paul, Minn., U.S.A. 821 pp.

G. Blix et al., eds.:

FAMINE - A SYMPOSIUM DEALING WITH NUTRITION AND RELIEF OPERATIONS IN TIMES OF DISASTER

Symposia of the Swedish Nutrition Foundation IX

The aims of the symposium were to establish contact on a broad basis between nutrition scientists with experience of hunger-stricken areas and representatives from international organizations which are engaged from time to time in relief operations and to develop recommendations of value for future action, including preplanning in relief work. The symposium was attended by 75 participants and the discussions were based on 17 presentations. The papers covered a variety of subjects such as causes of famine, degrees of starvation, effects on the individual, family and society, treatment and rehabilitation, and organization of relief programmes. Recent field experiences in Bihar (India), Nigeria, and among Palestinian refugees were discussed.

The symposium also recommended that: "Any use of starvation as a means of pressure or punishment against individuals, small or large population groups is a violation of the rights of man and should be outlawed".

Blix, G., Y. Hofvander and Bo Vahlquist (eds.). 1971. Famine: Nutrition and relief operations in times of disaster. Symposia of the Swedish Nutrition Foundation IX, Saltjöbaden, August 24-27, 1970. Almqvist & Wiksell, Stockholm, Sweden. 200 pp. 50 Sw. kr.

VITA:

VILLAGE TECHNOLOGY HANDBOOK

VITA, a private nonprofit corporation founded in 1959, has at present (1969) more than 5000 volunteers, living in 64 countries. This do-it-yourself handbook was conceived by VITA volunteers in 1962 as a means of bridging the "technological information gap" so essential for the progress of the world's villages and in this VITA has largely succeeded. Easy and inexpensive methods of overcoming the several practical problems of daily life (and death!) of the village community in the developing countries are described in simple language with many figures and drawings. Additional reading material for each item is suggested for those who wish to probe further.

All the information contained in the handbook has come out of practical experience in typical rural situations and on-the-spot study and application of the methods. This alone will make the technical data provided valuable. The book will doubtless have a great impact in all areas where active programmes of rural uplift are planned or in operation. Among the several sections there are two on food processing and preservation at home and home improvement.

VITA. 1970. Village technology handbook. Revised ed. Volunteers for International Technical Assistance, Inc., Schenectady, N.Y., U.S.A.

RECURSOS PROTEINICOS EN AMERICA LATINA

El Instituto de Centro América y Panamá (INCAP) inició sus labores en 1949 como una institución centroamericana de investigación, adiestramiento y asesoría en nutrición. Reconociendo como actividad de alta prioridad los estudios sobre la malnutrición proteica que afecta a las poblaciones de latinoamérica, y considerando la necesidad de dar a conocer la gravedad de este problema, organizó una conferencia bajo el título de "Recursos Proteínicos en América Latina". Dicha conferencia se llevó a cabo en la ciudad de Guatemala, del 24 al 27 de febrero de 1970, con el patrocinio del Fondo de las Naciones Unidas para la Infancia (UNICEF) y la Research Corporation, ambas con sede en la ciudad de Nueva York, E.U.A.

Se ha preparado un informe final sobre los acontecimientos que tuvieron lugar durante la Conferencia que incluye un total de 28 trabajos divididos en 5 capítulos, al final de cada uno de los cuales se resumen los comentarios referentes a los temas discutidos. Dichos capítulos comprenden una serie de trabajos presentados por expertos en sus respectivos campos de especialización.

El INCAP tiene gran placer en anunciar que el mencionado informe ha sido puesto en venta al público en el Instituto de Centro América y Panamá, Oficina de Documentos, Apartado Postal 1188, Guatemala, Guatemala, C.A. Precio: US$9.00.

RECENT PUBLICATIONS

Cépède, M. 1970. La science contre la faim. Presses Universitaires de France, Paris. Paperback, 135 pp.

Christensen, C. M. and H. H. Kaufmann. 1969. Grain storage: the role of fungi in quality loss. University of Minneapolis Press, Minneapolis, Minn., U.S.A. 153 pp. $6.50.

Food and Agriculture Organization of the United Nations. 1971. Technology of production of edible flours and protein products from groundnuts. Agricultural Services Bulletin No. 10. FAO, Rome, Italy. 88 pp.

Gray, W.D. 1970. The use of fungi as food and in food processing. CRC Press, Cleveland, Ohio, U.S.A. 113 pp.

Halliday, D. and J. G. Disney. 1971. Fish protein concentrate: a review. Tropical Products Institute Publication G 58. London, England. 18 pp.

Hammonds, T. M., and D. L. Call. 1970. Utilization of protein ingredients in the U.S. food industry. Part I: The current market for protein ingredients. A. E. Res. 320. Department of Agricultural Economics, Cornell University, Ithaca, N.Y., U.S.A. 29 pp.

Hammonds, T. M., and D. L. Call. 1970. Utilization of protein ingredients in the U.S. food industry. Part II: The future market for protein ingredients. A. E. Res. 321 (revised). Department of Agricultural Economics, Cornell University, Ithaca, N.Y., U.S.A. 36 pp.

Henderson, H. W. (compiler). 1971. Dictionary of international agricultural trade. Agriculture Handbook No. 411. Foreign Agricultural Service, USDA, Washington, D.C., U.S.A. 170 pp. $1.50.

International Union of Pure and Applied Chemistry. 1971. Collaborative study of a method for determination of concentration and purity of aflatoxin standards and use of the method for measuring stability of the standards. Technical Reports No. 1. IUPAC, Oxford, England. 20 pp.

International Union of Pure and Applied Chemistry. 1971. Minimum specifications for seven extraction solvents used in food processing. Technical Reports No. 2. IUPAC, Oxford, England. 20 pp.

Jelliffe, D. B. 1971. Nutrición infantil en paises en desarrollo. Spanish translation of "Child nutrition in developing countries" (1968). Office of Nutrition, Technical Assistance Bureau, US/AID, Washington, D.C., U.S.A. 261 pp.

Pomeranz, Y. and C. E. Meloan. 1971. Food analysis: theory and practice. Avi, Westport, Conn., U.S.A. 669 pp.

Pyke, M. 1968. Food and society. John Murray, London, England. 178 pp.

Pyke, M. 1970. Food science and technology. John Murray, London, England. 228 pp. £2.50.

Pyke, M. 1970. Synthetic food. John Murray, London, England. 145 pp. £2.25.

Strauss, E. 1969. Soviet agriculture in perspective. Praeger, New York, N. Y., U.S.A. 328 pp. $8.50.

PAG STATEMENTS AVAILABLE

No.	Title	Date
2	PAG Recommendation on aflatoxin	1969
3	PAG Statement on the nature and magnitude of the protein problem	1971
4	PAG Statement on single cell protein	1970
5	PAG Statement on the marketing and distribution of protein-rich foods	1971
6	PAG Statement on milk substitutes	1970
7	PAG Recommendation on prevention of food losses and protein-calorie malnutrition	1969
8	PAG Statement on plant improvement by genetic means	1970
9	PAG Recommendation on amino acid fortification of foods	1970
10	PAG Statement on a systems approach to the formulation and evaluation of nutrition intervention programmes	1970
11	PAG Statement on leaf protein concentrate	1970
12	PAG Statement on the world protein problem: research and development needs	1971
13a	Review of the specific proposals contained in ACAST report "International Action to Avert the Impending Protein Crisis" United Nations, 1968	1971
14	PAG Statement on marketing of conventional foods	1971
15	PAG Statement on popular participation and community involvement in nutrition improvement programmes	1971
16	PAG Statement on the potential of fish protein concentrate for developing countries	1971

PAG GUIDELINES AVAILABLE

No.	Title	Date
2	PAG Guideline for preparing food-quality groundnut flour	1970
4	PAG Guideline for preparation of edible cottonseed protein concentrate	1970
5	PAG Guideline for edible, heat-processed soy grits and flour	1969
6	PAG Guideline for pre-clinical testing of novel sources of protein	1970
7	PAG Guideline for human testing of supplementary food mixtures	1970
8	PAG Guideline on protein-rich mixtures for use as weaning foods	1971
9	PAG Guideline on fish protein concentrate	1971
10	PAG Guideline on marketing of protein-rich foods in developing countries	1971

PAG Statements and Guidelines may be used and quoted freely. Copies may be obtained without charge from the Protein Advisory Group of the United Nations System, N. Y. 10017, U. S. A.

PAG BULLETIN REFERENCE SYSTEM

Readers will note that this issue of the Bulletin is designated Volume 2, Number 1. In the future it is expected that the Bulletin will carry sequential volume and number designations on an annual basis. PAG Bulletin numbers 1 through 12 are to be considered the individual numbers of Volume 1.

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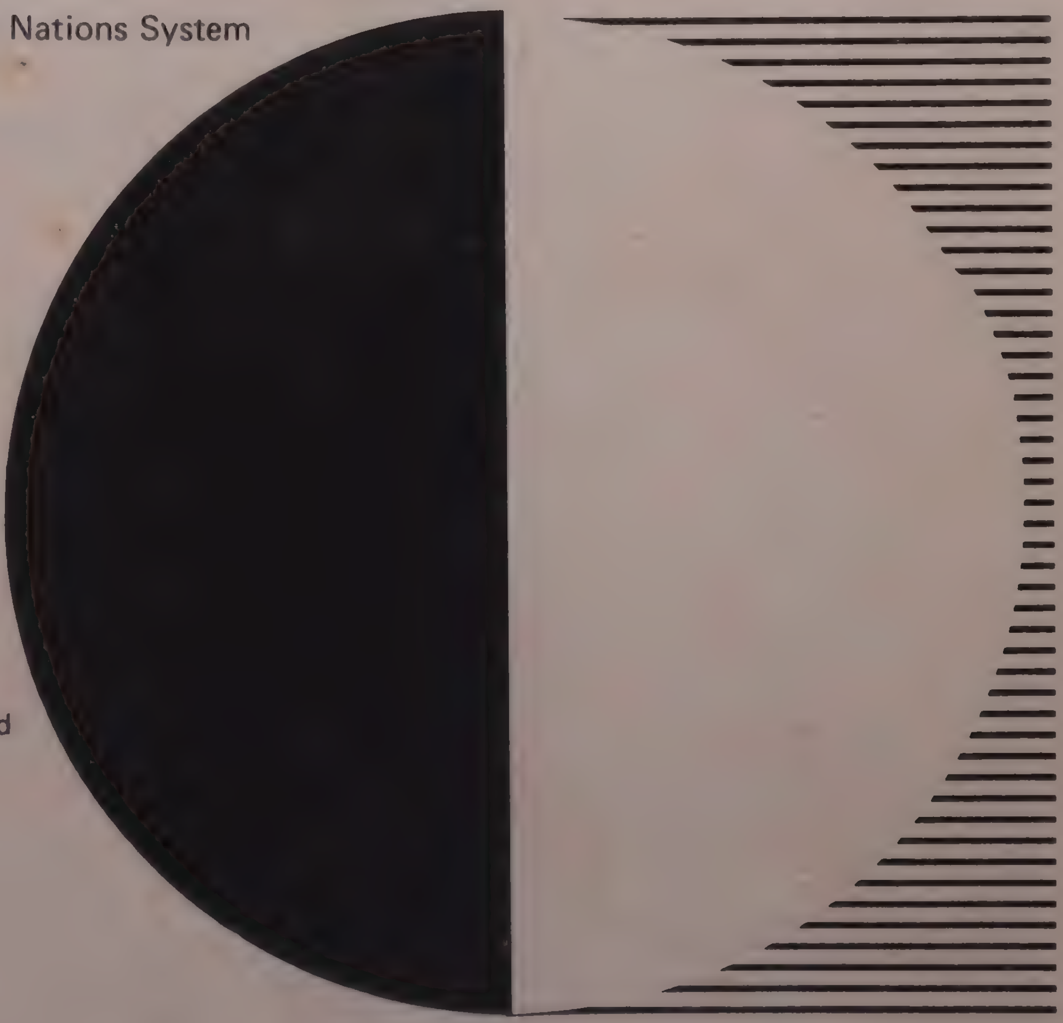
PAG BULLETIN

Protein Advisory Group of the United Nations System
United Nations, N.Y. 10017
U.S.A.



Food and Agriculture
Organization
of the United Nations
Rome

World Health Organization
Geneva

United Nations Childrens Fund
New York

International Bank
for Reconstruction and
Development
Washington

International review of action to improve world protein nutrition

THE PAG BULLETIN

PURPOSE

The _PAG Bulletin_ is published by the Protein Advisory Group of the United Nations System. Its purpose is to give information on the world protein problem to those individuals, academic institutions and industrial organizations who are interested in helping solve the protein problem and to promote the exchange of information in this field.

MAILING LIST

The _PAG Bulletin_ is sent without charge to persons, organizations, and companies with an active interest in proteins. The present mailing list comprises about 3000 names, approximately forty per cent in the U.S.A. and the rest distributed throughout the rest of the world. Requests to be added to the mailing list for the _PAG Bulletin_ should be addressed to the Executive Secretary, Protein Advisory Group of the United Nations System, United Nations, N.Y. 10017, U.S.A.

QUOTATION

Permission to quote items from the _PAG Bulletin_ is not required except from authors of signed articles. The Secretariat of the PAG would appreciate being informed of quotations made from the _PAG Bulletin_.

SUGGESTIONS

The _PAG Bulletin_ will be successful only if it reflects all aspects of the protein problem comprehensively and objectively. The Secretariat invites suggestions and ideas for broadening and deepening the scope of the _PAG Bulletin_.

SECRETARIAT

Staff members of the PAG Secretariat are:

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NOTE BY THE EXECUTIVE SECRETARY

In the course of a recent tour in Europe, I was impressed with the scope and vigor of several efforts to achieve industrial-scale production of a variety of novel protein resources. Some of these programs have been reviewed in previous issues of the PAG Bulletin. While it is apparent that the immediate objective of most of these expanding activities is to meet the growing feed-resource needs of domestic livestock industries, nevertheless it is also obvious that as they are perfected, these technologies will help to directly satisfy the human food protein requirements of Europe and those of the developing countries as well.

In France the B. P. Company is bringing into operation a 16,000-ton-per-year production facility for yeast from gas oil, thus markedly supplementing their pilot plant in Scotland which has been producing 4,000 tons per year from purified alkane fractions. Their stated objective is to provide protein concentrates with a level of purity, nutritional quality and freedom from toxicity as to permit their use directly for human food. Reduction of nucleic acid levels is a major consideration. In the U. S. S. R., pilot-scale production of yeasts and other microorganisms from petroleum fractions and pulp-mill wastes is expanding steadily, and very large investments in industrial production capacity are being committed in the current five-year plan to provide protein concentrates for animal feeding.

The Finnish Pulp and Paper Research Institute has developed a process for utilizing pulp-mill wastes as substrates for the production of certain microfungi which are easy to recover and to dry, and provide a highly nutritious animal protein supplement. Control of pollution of streams and waterways also appears to be a consideration in this effort. In Sweden, development is well advanced on a fermentation process to produce tryptophan, which promises to drastically reduce its cost. If cheap enough, this essential amino acid could make a major contribution toward upgrading the protein quality of diets based on maize. The Astra Company continues its extensive efforts to develop food and feed uses for its unusually bland fish protein concentrate. A sizeable pilot plant is being brought into operation by the Karlshamn's Vegetable Oil Factory, in a joint effort with the Alfa-Laval Company, to produce an edible-grade protein concentrate from defatted rapeseed residues. This involves removal of the toxic, sulfur-containing glucosides of this widely-grown oilseed species, to yield a protein with a remarkable biological value virtually equal to that of eggs.

The French Institute of Petroleum continues vigorously to expand its efforts, in collaboration with groups in several developing countries, to perfect various technologies for industrial-level production of protein resources based on yeasts and algae. The Lord Rank Research Center in England is making good progress in the scaling-up of its process to provide textured protein foods directly from a filamentous microfungus (genus Fusarium) grown on cheap carbohydrates. This group is also investigating the production of textured foods with protein filaments spun from legume proteins.

It is known that similar efforts are being pursued energetically in several other European countries (Italy, Germany, Hungary and Czechoslovakia, for example). It can be forseen that these activities will have an important impact on Europe's animal protein fodder needs, and soon thereafter will provide human food directly. Comparable progress can then be anticipated in several developing countries which are already experimenting with these technologies.

NINTEENTH MEETING OF PAG, GENEVA, DECEMBER 1971

The 19th meeting of PAG was held at WHO Headquarters, Geneva, Switzerland, 13-17 December 1971, under the Chairmanship of Professor N. S. Scrimshaw. Drs. H. A. B. Parpia and P. C. Spensley, members of the PAG, were not able to attend. Representatives from the sponsoring agencies, FAO, WHO, UNICEF and IBRD took part in the meeting. The representatives of the following other United Nations agencies and organs also attended and actively participated in the deliberations of the PAG:

The Advisory Committee on Coordination (ACC)
The International Atomic Energy Agency (IAEA)
The International Labour Organisation (ILO)
The Office of Science and Technology (UNO/OST)
The United Nations Development Programme (UNDP)
The United Nations Educational, Scientific and Cultural Organization (Unesco)
The United Nations Industrial Development Organization (UNIDO)
The United Nations Office, Geneva, Division of Social Affairs (UNO/DSA)

Also attending the meeting were a number of consultants and guests. The total number of participants was forty-eight.

The Chairman opened the meeting by welcoming all those present and stated that this is the first time the PAG is meeting under its new title, the Protein Advisory Group of the United Nations System. Dr. Dorolle, Deputy Director-General of WHO, pointed out that in spite of significant advances made in the field of agricultural production, food science and technology, the problem of protein deficiency and malnutrition has not shown any perceptible reduction. He stated that the decline in childhood mortality reported in many developing countries is more the result of specific public health programs preventing death and due less to any great improvement in the overall standards of living including general nutritional conditions. Thanking the PAG on behalf of the sponsors and all the other UN agencies for offering advice on various aspects of the protein problem, Dr. Dorolle indicated that he was pleased to note that the agenda for this session includes topics of great interest to the UN agencies such as national agricultural policy required to increase protein supplies, implications of the Green Revolution to protein supply, evaluation of nutrition rehabilitation centers and national strategy for supplementary feeding programs.

Protein discussions in UN interagency and intergovernmental bodies

The PAG deliberations on the above were concerned with the technical part of the report prepared by the Secretary-General's Expert Panel on Protein Strategy, the recommendations of the Administrative Committee on Coordination (ACC) on PAG affairs and the ECOSOC resolution 1640 (LI)* on edible protein and the implementation of the recommendations contained in the resolution.

While warmly commending the report of the expert panel and presentation of the several strategy issues, the PAG noted that the report has not sufficiently emphasized the environmental threat from improper use of toxic agricultural inputs which may lead to pollution of soil and water with serious consequences for food safety. Also, the important role that private enterprise could play in implementing the several strategy proposals, given appropriate incentives, was indicated and it was noted that the panel's report has not mentioned this aspect.

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*The resolution was published in PAG Bulletin Vol. II, No. 1, 1971.

Reviewing the ACC discussions and recommendations on PAG affairs, the members were pleased to note that representatives of the potential sponsors were able to attend the current session and to participate in the deliberations of the PAG as well as in the work of the Steering Committee. A special item entitled "Reaction of agencies to PAG programs and services" was on the agenda and the agency representatives other than those of the original sponsors were invited to indicate their interest in and concern for protein matters and particularly how they planned to become involved in PAG activities and to avail themselves of its services. The representatives expressed keen interest and desire for involvement in PAG activities and several indicated that serious consideration is being given to their joining in sponsorship of PAG. The PAG noted that an informal ad hoc meeting of sponsors and potential sponsors of PAG will be held following the PAG session to discuss problems arising from expansion of the PAG.

Regarding the operative para. 7 of ECOSOC resolution 1640 (LI), the PAG recommended the preparation of two types of reports, one an annual progress report and the other a three-year global overview. The annual report will not be a definitive review and will provide information on PAG activities during the year. The three-year overview will analyze the global protein problem viewed against the backdrop of available protein resources and national, international and bilateral activities in the field of proteins.

Strategies for establishing national supplementary feeding programs

The document prepared jointly by the World Food Programme and FAO provided the background. The discussions emphasized the need for proper evaluation of supplementary feeding programs before steps are taken to extend this activity to cover a large number of individuals or new areas. The several deficiencies of existing feeding programs were reviewed and the lack of any specific studies to evaluate their performance was noted. The PAG recommended a reexamination of this topic at the 20th PAG session with additional information on certain problems and aspects characteristic of large-scale feeding programs, before a statement on the subject can be prepared.

Agricultural policy at the national level required to increase protein supplies

Since cereals provide quantitatively a large proportion of the daily protein requirements of the populations of developing countries, the PAG emphasized the development of more concentrated sources of protein which should go hand-in-hand with increases in cereals and energy crops to ensure the adequacy of both calories and proteins. The selection of an appropriate pattern of agricultural production depends on the particular conditions in each country. The PAG considered in detail the problems of feeding resources for production of animal proteins and supportive policies and services to meet priority needs. Based on the discussion, the PAG prepared a statement on the subject.

Implications of the Green Revolution to protein supply

The discussion of this subject covered a variety of points such as inputs required, multiple cropping, effects on production of other crops such as legumes and vegetables, complementarity of land use, environmental problems such as pollution, foreign exchange needs, problems of preservation and transport and the need for further research on genetics of crops and their functional properties. Based on the discussion, the PAG prepared a statement on the subject.

Nutrition rehabilitation centers

Reviewing the present position and performance of nutritional rehabilitation centers (NRC's) currently in operation in several parts of the world it was felt that in areas where there is a high prevalence of PCM, NRC's are a useful means of reducing mortality and morbidity rates. The cost of recuperation of the child through such units has proved to be 10 to 15 times less than that in a hospital. However, for best results the NRC should operate as part of a comprehensive MCH program. An efficiently run center can serve as a training institution for doctors and public health personnel and also provide nutrition education for the mothers. Based on the discussion, the PAG prepared a statement on the subject.

Report of the ad hoc Working Group on Single Cell Protein

The PAG accepted the report and approved its issue as a PAG document. A brief summary of the meeting was presented in Bulletin Vol. II, No. 1. The guideline on production of single cell protein for human consumption is presented separately on p. 21 of this Bulletin.

Report of the ad hoc Working Group on Feeding the Preschool Child (Third Meeting)

The PAG accepted the report with some minor modifications and approved its issue as a PAG document. A brief summary of the report is published elsewhere in this Bulletin.

Report of the ad hoc Working Group on Milk Intolerance

In considering this report, the PAG noted that this topic is of current importance, especially since the mass media have recently featured it and not infrequently in a one-sided and distorted manner. Based on the report of the ad hoc Group, the PAG concluded that the evidence presently available does not justify the doubts expressed in some quarters as to whether it is desirable to use milk as a source of supplementary food for children in the developing areas of the world and whether milk and milk products should be exported throughout the world for use in nutrition programs.

The PAG prepared a statement entitled "Low lactase activity and milk intake" for issue. The report of the ad hoc Group was accepted and approved for issue. A summary of the report and the complete statement appear in this Bulletin on page 7 .

Special problems in marketing of protein-rich foods

The PAG felt that the Group should review at the 20th session the current status of low-cost protein-rich food mixtures available and commercially distributed through the market in different parts of the world. The lack of data on consumer behavior and attitudes, particularly toward breast-milk replacers and protein-rich weaning foods which affect breast feeding, was noted. The impact of the commercial promotion of brands of baby foods on the decline of breast feeding as well as the benefits derived from their availability in the community should be investigated.

Nutritional and food quality guidelines for plant breeders

The need to orient plant breeders, who are intensifying efforts on breeding food crops for several agronomical qualities, toward the importance of nutritional, food quality and consumer preference criteria which should be taken into account in breeding programs was discussed. Based on this discussion, the PAG prepared a statement on this subject.

Aflatoxin and human morbidity

The Group noted that the epidemiological data available at this time do not in themselves establish a direct causal relationship between aflatoxin exposure and human disease. However, the field data together with results of animal experiments support the hypothesis that the aflatoxins are an important contributing factor in the etiology of primary liver cancer and possibly other liver diseases. Moreover, experimental evidence indicates that the nutritional state influences the response of an individual to aflatoxin.

Available evidence does not justify any change in the recommendation of the PAG made in 1966 on the acceptable levels of aflatoxin in foodstuffs. This level should continue to be reviewed annually.

Alternative uses of fish for food and feed purposes

The technological aspects of the problem of alternative uses of fish for both human consumption and animal feed was presented with reference to the fish products available, the processing problems at various levels of industrialization, the nutritional and microbiological problems and, in particular quality control, safety and the influence of environment.

The other items on the agenda briefly considered by the PAG were recommendations of the FAO/WHO Joint Expert Committee on protein and energy requirements, the consultant's summary report on evaluation of effectiveness of national and regional institutes of research and training in nutrition, food science and technology (this subject will be taken up again at the 20th session), protein concentrates from rapeseed and mustard seed and emulsifiers for improvement of protein-fortified bread.

PAG AD HOC WORKING GROUP MEETING ON FEEDING THE PRESCHOOL CHILD

The third ad hoc Working Group Meeting on Feeding the Preschool Child was held at the Pan American Health Organization Headquarters, Washington, D.C., on 26 to 28 October, 1971. The members of the Group were Professor Bo Vahlquist, Sweden (Chairman); Professor M. Gabr, Egypt; Dr. O. Ballarin, Brazil; and Professor P. Satgé, France. Dr. V.K. Tatochenko, U.S.S.R., was not able to attend. Dr. Martin Forman, U.S.A., attended the meeting by special invitation. The representatives of the Agencies were FAO, Dr. G.D. Kapsiotis; WHO, Dr. J.M. Bengoa; UNICEF, Dr. L.J. Teply; IBRD, Mr. Charles Weiss; and WHO/PAHO, Drs. R. Rueda-Williamson, J.G. Chopra, B. Bosley, R.R. Puffer, C.V. Serrano and D.B. Jelliffe. Dr. Katherine Bain, U.S.A., Mrs. Patrice Jelliffe, Jamaica, and Mr. S. L. Pearson, UNICEF Consultant, attended the meeting as observers. Dr. Max Milner and Dr. P.S. Venkatachalam represented the PAG Secretariat. Professor N.S. Scrimshaw, Chairman of the PAG, also attended the meeting.

The ad hoc Group considered among others the following subjects relevant to feeding the preschool child in the developing areas of the world: a) causes of infant and childhood mortality, the methodology of measurement and nutritional and health implications; b) criteria for identification of mothers and preschool children at risk of developing malnutrition; c) nutrition rehabilitation centers; d) water requirements of infants and e) acidified and fermented milk for feeding infants and children.

In discussing infant and child mortality in developing areas of the world, the Group felt that the decline in mortality in children under 5 years of age that is being observed in many countries, unless carefully examined, may suggest that the nutritional situation is improving much more rapidly than is really the case. Actually, the available evidence indicates that the decline in mortality is probably due more to specific public health action to prevent deaths than to any improvement in the overall standards of living, including the general nutritional condition in the country. The present situation in developing countries seems to be very different from the situation of developed countries 30 or 50 years ago, where the drop in mortality probably was due mainly to the improvement in the standard of living. Under these circumstances mortality rates alone may not be a satisfactory criterion of the nutritional health of the community.

Mortality studies in children using the multiple-cause approach have provided useful data on the epidemiology of malnutrition, the close interaction of nutrition and infection, and the association between environmental factors, malnutrition and mental development. The multifactorial causality present in child mortality should be noted by public health workers as an indispensable basis for planning and development of preventive programs to protect mothers and young children, the most vulnerable groups of the population.

The role played by malnutrition of both the mother and the child in child mortality and morbidity is now more clearly recognized than before and this is sufficient justification for assigning high priority for nutrition activities, within the context of comprehensive MCH programs.

Since the patterns of mortality and the associated conditioning factors present wide variations from one place to another, it is essential to consider the specific characteristics of the problem and the local situation before planning and developing public health programs to lower and/or prevent the high rates of childhood mortality. However, some basic conclusions from epidemiological studies in children are applicable as general principles to any program for preventing the deaths of children and ensuring for the survivors good health and the full attainment of their genetic potentialities of physical growth and mental development.

The concept of identifying the child, the family or a community as one exposed to the special risk of development of malnutrition, using what are known as "at-risk" factors, was discussed and the value of this approach in special situations was recognized. It was noted that this subject is the title of a special meeting to be held by IUNS in 1973.

The types of nutrition rehabilitation centers, their activities and evaluation were discussed and the Group concluded that the centers are a useful component of a general network of services, which are all aimed at preventing and treating malnutrition in the vulnerable preschool child age group. (This subject was further discussed in great detail at the 19th PAG meeting; see p. 3).

The subject of water requirements was considered separately, for the normal infant, the malnourished child and the dehydrated child. The Group noted that in spite of many reports on water requirements of dehydrated infants and children, there is not much information on the water needs of normal and malnourished infants. Although some general recommendations were made, the Group suggested the need for further research in some of the important areas where information is lacking. The available information on the production and use of acidified and fermented milk was reviewed. The Group noted that although there are certain benefits in their use for infant and child feeding and the products are extensively used in the U. S. S. R. for this purpose, their use presents certain problems in many countries. The claims of the beneficial effects of acidified milk also deserved further investigation and confirmation. The ad hoc Group also made a recommendation for further research on each of the topics discussed at the meeting.

(The full report of the ad hoc Working Group meeting is available as PAG Document 1.14/26).

PAG AD HOC WORKING GROUP ON MILK INTOLERANCE - NUTRITIONAL IMPLICATIONS

The PAG ad hoc Working Group met at the headquarters of the Pan American Health Organization, Washington, D.C., U.S.A., on 29 and 30 October 1971. The members of the Group present were: Professor Bo Vahlquist (Chairman), Sweden; Dr. R. Luyken, The Netherlands; Professor M.C. Latham, U.S.A.; Professor G.G. Graham, U.S.A.; Dr. V. Reddy, India; and Professor O. Ransome-Kuti, Nigeria. Dr. O. Ballarin, Brazil; Professor M. Gabr, Egypt; and Professor P. Satgé, France, attended the meeting as guests. The following representatives of the Agencies participated: FAO, Dr. G.D. Kapsiotis; WHO, Dr. J.M. Bengoa; UNICEF, Dr. L. Teply; WHO/PAHO, Drs. R. Rueda-Williamson, J.G. Chopra, B. Bosley and D.B. Jelliffe. Dr. Katherine Bain, U.S.A., and Mrs. P. Jelliffe, Jamaica, attended the meeting as observers. Professor N.S. Scrimshaw, Chairman of the PAG attended and Drs. M. Milner and P.S. Venkatachalam represented the PAG Secretariat.

The ad hoc Group reviewed the work undertaken in various parts of the world on the problem of low lactase activity of primary origin and its practical implications on milk usage in developing countries.

Clinical conditions exhibiting low lactase activity

The ad hoc Group considered congenital lactase deficiency and low lactase activity due to other factors and noted that the former is a rare condition due to an hereditary disorder and the latter, associated with very many disease states, is a frequent cause of unexplained diarrhea among infants and young children in developing areas of the world. It was emphasized that unless information regarding lactase activity in a healty state prior to the illness is available, it is generally difficult to know in non-Caucasians whether the low lactase activity is due to a primary absence of the enzyme or is secondary to the observed illness.

Primary low lactase activity and milk intolerance

The four terms commonly used in the literature were defined (see definitions on p. 9 under PAG Statement No. 17 on Low Lactase Activity and Milk Intake following this report) and the methods of diagnosis were indicated.

The manifestations of intolerance to lactose, whether due to congenital, primary or secondary low lactase activity, are similar, although in the rare congenital variety the reaction is usually more severe. When symptoms of intolerance occur, they may include one or more of the following:
1) abdominal pain, cramps and discomfort;
2) diarrhea and abnormalities in the stool; and
3) production of gas leading to bloating, flatulence, etc.

The mechanism responsible for these symptoms has not been fully investigated. However, lactose remaining in the gut lumen acts as a hydragogue, causing a net water movement from the plasma to the gut lumen. This is a result of the effective osmotic pressure of the lumenal contents containing the nonabsorbable solute being higher than that of the plasma. The accumulated water causes distention, provoking increased intestinal motility. The undigested lactose, upon reaching the colon, serves as a substrate for colonic bacteria; fermentation occurs with the production of organic acids, mainly lactic and acetic acids. These act as irritants, causing increased peristalsis and subsequent diarrhea. Bacterial degradation also results in the production of gas, mainly carbon dioxide.

Prevalence

Studies on the prevalence of lactose intolerance have been carried out in many parts of the world. The majority of the studies are confined to adult subjects and not many data exist on the prevalence of the condition in children of different age groups. A number of these studies have been conducted on small groups of subjects chosen from those hospitalized for some ailment. Also, it is not clear whether efforts were made to distinguish between primary and secondary absence of lactase. Another important limitation of most of these studies, from the practical point of view, is that they were primarily oriented toward determining the prevalence of low lactase activity using techniques such as intestinal biopsy and oral lactose load tolerance tests and relating the presence or absence of clinical signs and symptoms to the lactose load. While this information is of great value in itself and a significant contribution to the understanding of the problem, the results of these studies cannot indicate the response of a subject with primary low lactase activity to consumption of graded amounts of animal milk. Any interpretation of the results of these studies should therefore keep in mind the limitations mentioned above.

The ad hoc Group noted that the prevalence of low lactase activity, lactose malabsorption and lactose intolerance in adults is low (about 1%) in Europe. In North America, the frequency based on abnormal tolerance tests seemed to be slightly higher (6 to 19%) for the white American population, and for black Americans the corresponding values were significantly higher (72 to 77%). More studies on children of different age groups are required, particularly on black and white children in North America.

The prevalence of low lactase activity in Africa, Asia, the Middle East and in Latin America is high and the figures seemed to vary from 50 to 100% in the different studies. The two predominant points which emerge from most of these studies are: 1) a lack of relationship in individual subjects between the ingestion of milk and the results of lactose tolerance tests. The answer to this may lie in the fact that intolerance to milk consumption for each individual subject may depend on a particular quantity of milk consumed and each person has learned not to exceed his limit. 2) There is a very high incidence of low lactase activity and lactose malabsorption among the adult populations studied in Asia, Africa, the Middle East, and Latin America and the nonwhites in the U. S. A. However, not all of these people show lactose intolerance to the standard lactose load. The phenomenon appears to be less frequent among children and seems to develop progressively with age.

Clinical and nutritional implications

The ad hoc Group examined the meager information available regarding milk consumption practices in the developing areas of the world and the extensive literature available on its use in the treatment and prevention of malnutrition and particularly PCM. It was able to review the experience in the use of milk in preschool child feeding programs and school lunch programs. The Group felt that on the basis of current evidence, the quantity of milk fed in these programs will rarely lead to disturbing clinical signs and symptoms due to low lactase activity. Lactose intolerance need not pose any clinical problem insofar as protein therapy of PCM with milk is concerned in hospitals and in other institutions possessing adequate facilities.

The occurrence of low lactase activity in the majority of the adult population in developing areas of the world has made it necessary to evaluate the nutritional implications of milk consumption with special reference to the role of milk as a source of protein and other nutrients for the vulnerable groups. In individuals with clinical manifestations after milk consumption, it is probable that absorption of protein and other nutrients will be affected. However, the important nutritional concern is whether in those with no alimentary signs or symptoms and who form the large majority, milk feeding will affect the absorption of protein and other nutrients present in milk. Further research is necessary to evaluate this aspect, particularly in children fed ordinary as well as lactose-free milk in different quantities commonly used in child feeding programs. Again, there is no information on whether low lactase activity affects absorption of nutrients other than protein in milk. Nevertheless, the available data suggest that a variable quantity of the lactose of milk may be lost in the stools, implying a loss of calories from this carbohydrate source. More information is required with respect to digestion and absorption of various milk nutrients by persons with low lactase activity consuming the customary amounts of milk.

Efforts are underway in many developing countries to actively promote dairying and milk production. Large quantities of milk and milk products are also donated through international and bilateral aid programs to developing countries as support for various large-scale nutrition feeding programs. Since milk feeding is recommended primarily to offer some high-quality protein to the consumer, on the present evidence there is no basis for discouraging programs where the aim is to improve milk supplies and increase milk consumption.

The use of low lactose preparations for special situations and the production and use of low-cost protein-rich foods using proteins from vegetable sources containing small amounts of dried skim milk powder were reviewed and the priority areas for research in this field listed.

(The report of this meeting is available as PAG Document 1.27/9).

PAG STATEMENT 17 ON LOW LACTASE ACTIVITY AND MILK INTAKE

During the last few years, reports have appeared in the world medical literature on the occurrence of low intestinal lactase (exact term: β-galactosidase) activity in large groups of apparently healthy nonwhite populations in different parts of the world. Some of the reports and many articles in the lay press have concluded that milk consumption by these people may lead to untoward reactions in the form of gastro-intestinal disturbances ("milk intolerance") and may interfere with the proper utilization of milk nutrients. Doubts have been raised as to whether it is desirable to use milk as a source of supplementary food for children in the developing areas of the world and whether milk and milk products should be exported throughout the world for use in nutrition programs.

It is the considered view of the PAG based on the report of its *ad hoc* Working Group on Milk Intolerance that the evidence presently available does not justify the above doubts, for the following reasons.

The results obtained with standard lactose tolerance tests, the procedure most commonly used to evaluate intestinal lactase activity, cannot be used as indicators of milk intolerance. Low lactase activity, lactose intolerance and milk intolerance are not synonymous[*] although they have been used as such in many publications. An intolerance to lactose in the large amounts commonly used in load tests (50g of lactose or more per m^2 of body surface) which correspond in an adult to the consumption at one time of 1.0 - 1.5 liters of milk, gives no information on the existence of milk intolerance when the milk is consumed in moderate quantities.

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[*] Definition of terms

Low lactase activity: Less than 2 units of lactase activity per gram wet mucosa

This can be demonstrated in either of two ways:

a) directly by examination of biopsy material
b) indirectly by lactose tolerance test ("flat" blood sugar curve, i.e. rise of 25 mg % or less following ingestion of standard lactose dose: 50g/m^2 or 2g/kg in children)

Lactose malabsorption: Reduced absorption of lactose, a consequence of low lactase activity, determined by lactose tolerance test described above.

Lactose intolerance: Clinical signs (abdominal pain, diarrhea, bloating, flatulence, etc.) following ingestion of lactose, mixed in water in standard dose or less, in a person with proven lactose malabsorption.

Preschool child feeding programs and school lunch programs, which have been in operation in many developing areas of the world for well over two decades, use only about 200ml to 250ml of milk per day and in many programs this is taken with other food. This quantity of milk contains only about one-quarter of the amount of lactose used in standard load tests for these ages. Skimmed milk powder, which is used in many of these programs, contains more lactose than whole milk. Even so, consumption of reconstituted skimmed milk powder will offer a lactose load considerably below that used in lactose load tests. These load tests measure the presence of enzyme activity and not the capacity of the child to tolerate the quantity of milk which he normally consumes.

Practical experience in the field has demonstrated that some of the children who reject the regular quantity of milk during the initial stages of a program are able to accept the same amount after they are accustomed to it. In areas where the population is not accustomed to milk drinking, it might be prudent to start milk feeding programs with reduced amounts of milk, and increase the quantity gradually to the regular dose.

It has been reported from one industrialized country that a large number of nonwhite elementary school children receiving milk as part of the school lunch consumed only one-half or three-quarters of the daily quota of milk supplied. This has been stated to be the result of low lactase activity, but it remains to be proved; low milk intakes have also been found in studies of North American and European school children in whom low lactase activity was not a factor.

In all the investigations on lactase activity available so far in the literature, the total number of children included is relatively small and among these studies there are comparatively few systematic surveys on prevalence. Reasonably-sized groups have been investigated for lactase activity mainly in Northern Europe and the number involving children in different age groups is very limited. The information available regarding prevalence in populations in Asia, Africa and Latin America is much less and only recently have adequate attempts been made to include children from such groups as subjects for investigation.

There is a great need to undertake further prevalence studies among children of various ages in nonwhite populations, using standard and comparable procedures, before the extent and magnitude of the problem of low lactase activity, the age at which the fall in activity occurs in various populations and the implications of the findings for milk consumption by children can be assessed.

Milk is considered a virtually complete food and in the developing areas of the world, where protein deficiency is widespread and protein-calorie malnutrition a serious childhood problem, the use of milk for child feeding programs is strongly advocated by all nutrition experts. The PAG wishes, however, to emphasize that there are several areas where our knowledge is deficient or lacking on this complex subject and steps should be taken to close the gaps. Physicians in developing countries and authorities supervising milk feeding programs should also be made aware of current knowledge on this subject and its implications.

Milk intolerance due to lactose content: Clinical singns (abdominal pain, diarrhea, bloating, flatulence, etc.) consistently following a few hours after ingestion of milk or milk-containing products in usual amounts in a person with proven lactose malabsorption.

It would be highly inappropriate, on the basis of present evidence, to discourage programs to improve milk supplies and increase milk consumption among children because of the fear of milk intolerance.

THE POTENTIAL OF FISH PROTEIN CONCENTRATE FOR DEVELOPING COUNTRIES

The following is the first part of PAG Statement 16 on FPC. The remainder, which also contains the bibliography, will appear in the next issue of the PAG Bulletin.

1. Introduction

Fish is an important world resource of high quality protein, but it can be expensive to conserve in a form fit for human use. In some countries, the rational utilization of the available fishery resource offers promise of making a contribution to the solution of protein-calorie malnutrition. One possible way of stabilizing fish proteins for human consumption in developing countries is to convert them into fish protein concentrate (FPC) (Library of Congress, 1970).

Populations vary in their acceptance of fish and fish products. Many favour the flavours of fish although those of certain species may not be acceptable. Some tolerate the flavours of fish that have been subjected to a degree of chemical, autolytic or bacterial degradation; others prefer them and yet others reject them.

The form in which fish is presented for marketing and for consumption is important. In a number of developing countries the whole, intact, ungutted fish is preferred. In others, fillets, split or comminuted fish find a good market. Preferences for the various forms of cured fish vary also. Price is a critical factor in marketability and utilization.

This diversity of acceptability patterns and their changing nature argue for flexibility in approaches to the exploitation of the fisheries resource for human food (Halliday and Disney, 1970). Fluctuations in the availability of raw material and continuing development in preservation and processing technologies argue similarly, as do developments in the production and technologies of competing protein resources.

Four consumer groups are of particular concern in the context of protein malnutrition in the world: the weanling, the preschool child, the nursing mother and the expectant mother. It may often not be possible to channel particular products to individual groups. Nevertheless, a degree of differentiation between these groups in patterns of utilization of different types of products may be practicable. For instance, it is arguable that the weanling's requirement for finely particulate food of high microbiological quality may best be met by the production of high-grade bland powders available at low prices and which are competitive with other proteins in real terms. Equally, it is arguable that such powders prepared from fish may meet with serious competition from other fishery products in their overall acceptability to other age groups, particularly adults. For instance, it is recognized that "texture" is often a factor in acceptability and that strongly flavoured products are often desirable dietary ingredients. In this general context it is ironic perhaps that, currently, considerable research and development effort is being directed towards the texturizing and flavouring of vegetable protein products while most current approaches to FPC development remove textural and flavour features that many potential consumers would regard as attractive. Consequently, as well as examining FPC's in comparison with protein products from vegetable or other sources, it is desirable to consider them also against the broader background of the availability and price of alternative fish products. Given these alternatives, it is necessary to evaluate, for each set of circumstances, whether FPC's may be able to contribute economically to the alleviation of protein deficiency in developing countries, the extent to which investment in present and possible future processes in such countries may be justified as compared with investment in alternative protein foods or supplements, and what criteria should be applied to the FPC's.

2. Product properties and uses

2.1 Definition and nomenclature

The following definition is used in this statement:

> "Fish protein concentrate (FPC) is a stable product suitable for human consumption prepared from whole fish or other aquatic animals or parts thereof. Protein concentration is increased by the removal of water, and, in certain cases, of oil".

Traditionally dried fish and other traditionally preserved fish, while falling within this definition, are arbitrarily excluded from discussion in this statement.

Various names have been used for products falling within this definition of FPC. These include fish flour, marine protein concentrate, whole fish protein concentrate, fish protein, eviscerated fish protein and fish meal for human consumption. The view has been expressed that the use of the word "fish" in the name fish protein concentrate might adversely affect the marketability of the product in certain countries. It should be recognized that other descriptive terms can appropriately be applied to products meeting the general specifications of FPC's; the use of such other names should be accepted in countries where the term fish protein concentrate is unacceptable or undesirable. However, it is recommended that the use of the term "fish meal for human consumption" and the qualified terms "FPC, human-grade" and "FPC, animal-grade" be discouraged.

2.2 Types of products

FPC represents a broad class of products which may be prepared from fish by a variety of methods. These may range from light-coloured, bland and odourless materials to dark products that have an intense fishy taste and odour.

FPC's have been categorized in two groups, type A and type B, on the basis of their chemical composition and organoleptic characteristics (FAO/WHO/UNICEF Protein Advisory Group, 1970a). This separation into types should not be taken to imply superiority of one over the other in nutritional, functional or other quality factors. As indicated later, this type of categorization is unsatisfactory and more appropriate definitions and tests for each type of FPC should be developed as they become available.

Type A products are essentially odourless and bland powders containing very low concentrations of lipids and being usually of light colour. Type B are often flavourful, have a higher content of lipid, and may have various physical forms (powders, pastes, liquids, etc.).

Type B includes FPC's made by solvent extraction and other processes, some of which are listed in Appendix II. The criteria used to define type B products should be such as to include a number of useful FPC's which do not meet arbitrary requirements for protein and fat content. It is recommended that there should be no upper or lower limits for protein and lipids in type B FPC's. It is assumed that stability requirements would be met by specific stabilization of the fat and that protein levels would exceed those of the raw fish.

Currently only FPC's produced by isopropyl alcohol (IPA) extraction or by ethylene dichloride (EDC) - IPA extraction meet type A characteristics. In addition, some products which may be prepared by the heat transfer method (HTM), as proposed by Greenfield (1953), and FPC's prepared by aqueous extraction or by enzyme hydrolysis, presently only in laboratory production, may fall into this category.

A family of FPC-type products of particular interest fall outside the strict definition of FPC since they contain other ingredients added during processing. Some of these fall into the category of milk substitutes. They may be prepared by partial hydrolysis of fish muscle and may be stable and highly nutritious. The process developed by Rutman and Heimlich is an example of this approach. These are potentially very useful products.

2.3 Quality and safety

In defining guidelines, standards or specifications (FAO/WHO/UNICEF Protein Advisory Group 1969a and b, and 1970a and b) for FPC's it is important to distinguish safety factors from quality factors. While there should be no compromise on safety, quality standards should be quite flexible and depend on the anticipated end-use of the product.

As examples of this approach, the limits proposed in certain specifications for fluoride and for IPA residues often appear to be too restrictive and not justified on either a safety (Zipkin, Sergio and Stillings, 1970) or a use basis. The permissible fluoride level should be determined by the country within which the FPC is to be used and in accordance with the fluoride intake from other sources of food and water by the target group. In any case, it should, when possible, not be so stringent as to prevent the use for FPC manufacture of otherwise desirable species of whole fish with naturally high fluoride content. As a guide, an upper level of 250 ppm is suggested.

To attain the residue level of IPA specifications necessitates steam sparging of solvent-extracted FPC. This adds significantly to the cost of production and it can reduce the biological value of the FPC (FAO, 1970). It is recommended that the level be set at that appropriate to "good manufacturing practice" as set forth in the regulations of the Canadian Food and Drug Directorate. If a numerical upper level is desired, 5000 ppm is suggested. This appears consistent with the findings of Wills *et al.* (1969) who showed that a level of 6.4 mg/kg body weight of IPA consumed over a 6-week period appears to have no toxic effect.

The microbiological criteria proposed for FPC should ensure microbiological safety. It is suggested, however, that requirements in this respect need be no more stringent for FPC than for dried powdered milk, where it has a similar pattern of use.

Available evidence (Goldmintz and Hull, 1970) indicated that FPC prepared by the IPA solvent-extraction process can easily meet such microbiological requirements. Particular care should be taken in the case of nonsolvent-produced FPC's since these do not benefit from the antimicrobiological action of the solvents and heat. It may be noted that some solvent-extracted fish meals are claimed to meet strict microbiological standards.

The possibility exists that species of naturally toxic fish could be included in mixed catches taken in certain parts of the world (Bagnis *et al.*, 1970) and that these might unknowingly be used for FPC manufacture. There is no information available on the effect of solvent or other processing procedures on the poisonous substances responsible for the toxicity of these fish, but it is probable that some would be unaffected by such processing. Others of the toxins might, however, be separated into the lipid fraction in processes where fat is removed. It is recommended that such fish be avoided as raw material for FPC manufacture. This should normally present little difficulty since toxic species would not normally be taken in the one-species fisheries which so far appear to provide the only reasonably economical raw material for potential FPC manufacture.

On occasion it has been proposed to use shellfish, particularly mussels, for the manufacture of FPC. Here, it should be noted that paralytic shellfish poisoning is an annual problem in various parts of the world. In these instances, shellfish become toxic as a result of feeding on toxic dinoflagellates. Therefore, if such raw material is proposed, the beds from which the mussels are taken should be periodically tested for toxicity and when results are positive, FPC manufacture should be suspended until the shellfish clean themselves of the toxin; this process takes a few days after the dinoflagellates disappear from the food chain.

There has been concern recently over the occurrence of heavy-metal compounds in fish. Because of their position high in the aquatic food chain, fish tend to concentrate persistent chemical compounds entering the environment as pollution. Fish caught in inshore waters near industrialized areas may contain relatively high levels of mercury, lead, etc. It is unlikely that the contamination hazard would be significant in the type of fish most probably used for FPC manufacture, namely the mostly highly mobile, pelagic species caught some distance offshore. There are, however, some species or even races of fish which appear to have naturally-occurring levels of mercury and lead which are high enough to cause FPC's made from them to approach levels close to tolerable concentrations as often set by regulatory agencies. Since FPC would, if economical, be used only as a supplement in small quantities, this fact should be taken into account in setting limits for such contaminants.

There is no evidence that the use of FPC could be dangerous in this respect, but monitoring for heavy metals should be carried out on a regular basis, when FPC is produced. A watch should also be kept on the possibility of toxic substances being introduced during processing.

In regard to quality criteria, as distinguished from safety considerations, there is a need to maintain breadth and even flexibility. This applies particularly to the protein and lipid contents as already mentioned; but it also includes the water content. These should be related to the end use of the product and not be subject to arbitrary limits.

Review of the processes available for FPC manufacture indicates that some potential products may have a somewhat lower protein content and almost certainly will have more fat than type B products as defined, for instance, in the document referred to above. Such products would, however, still be valuable as protein supplements. They should not be excluded from manufacture and use by arbitrary standards or guidelines.

FPC's prepared by the presently known methods using good manufacturing practice are highly nutritious. Some damage may occur to the amino acid content as a result of improper processing practices, e.g. excessive heating, and there is some evidence of slightly lower biological efficiency in FPC's prepared by certain biological processes. The nature of such damage may need to be investigated to determine the type and amounts of amino acids affected. Since FPC's are proposed to be used as supplements in protein-deficient diets which are short of one or more essential amino acids, it is important that any manufacturer provide information for each type of FPC concerning its profile of available amino acids. This is particularly important in the case of the essential amino acids and especially lysine and methionine. In general, protein efficiency at least equal to that of casein should be expected from FPC's.

Since a major proposed use of FPC is as a food additive, it is important that its organoleptic characteristics (in the compounded food) be acceptable to the consumer and that its functional properties be appropriate for the food use intended. Flavour and odour may be bland or pronounced. In the latter case they must either be capable of being masked by the flavour of other components in the final compounded food or they must be directly acceptable and usually desirable to the consumer. Strongly flavoured or highly odoriferous FPC's need not be completely discounted, but it should be recognized that the use of such products to supplement certain foods designed for particular classes of consumers, e.g. babies, may be difficult. It is important also to recognize that ingredients in baby foods should meet with the approval of the mother who prepares and serves the food as well as the baby. However, it is recognized that, for older consumers, the presence of strong flavours, as may occur in type B products, often enhances acceptability in developing countries, where powders prepared from traditionally dried fish meet with a ready sale. From the organoleptic point of view it is important that FPC should not alter the texture of foods to which it is added in a manner which the consumer or food preparer finds objectionable. The most common problem with the present generation of solvent-extracted FPC's is grittiness, which may be eliminated if the products are sufficiently finely ground. Grittiness will be a greater problem in some foods than in others. Since achieving fine mesh particle size by milling is a process which adds substantially to the final cost of FPC, it would be useful for potential FPC users to determine what degree of coarseness can be accepted for particular uses and express this in terms of mesh size. This would imply that any FPC manufacturer should provide information on mesh size as part of the product description.

Functionality in the food technologists' meaning of the word implies the possession of properties which affect the ability to serve a function in food apart from the purely nutritional one. Common functional features are ability to whip into a stable foam, emulsifying and fat binding capability, wettability, water absorption, fat absorption and solubility. Complete absence of reactivity of a protein in compounded foods has been considered by some as a functional property in the sense that the protein can be used without alteration of the natural characteristics of the food. This is the only type of functionality shown by any FPC currently available or which seems likely to be available in the near future. In its role as a nutritional supplement, this lack of positive functional capability by FPC may sometimes be of value. A good deal of work is going on to attempt to develop functionally active FPC's but these are designed primarily for the food additive markets of industrialized countries where the need for nutritional supplementation is not acute and higher unit price can be accepted. There would be advantages in a functional FPC for food supplementation in developing countries also, particularly for some types of food preparations such as soups, drinks, and some pasta products.

Functional properties, taste and odour effects can be assessed only by trials with the food itself and this should be done as a first step in any consideration regarding establishing FPC supplemented foods. Methods for such testing should follow a standard format and results be presented in a consistent way so that effective comparisons can be made between test batches. Standards should be available against which the performance of new systems can be evaluated.

A standardized methodology for such testing does not presently exist. However, a detailed proposal has been prepared in the U.S.A. (Stillings, 1970). Such an agreed system would be valuable to facilitate comparisons among any classification of various FPC's. Any elaboration of such methodology should also take into account the need for comparisons with other protein supplements. The existence of such standardized methods might also eventually prove useful for quality control purposes.

2.4 Acceptability

Testing of the type mentioned above may help to establish useful levels for FPC in foods in terms of technological characteristics. Acceptability by the individual consumers or food preparers will be indicated by organoleptic testing, but more reliable information can be obtained only by direct consumer testing after screening tests have indicated probable acceptability (Kapsiotis, 1965; General Oceanology, Inc. 1970a and b; Monckeberg, Donoso, Chichester, Ballester and Yanez, 1970; and Anon. 1970). In this connection the point referred to earlier concerning acceptance of added flavour in foods by various age groups, regional and country groups, etc., is of first importance. In any proposed use of FPC, a review of the food habits of the target groups should always precede selection of the food to be supplemented and the type of FPC to be used. Where adult groups or older children are involved it might be possible to mask FPC flavours, where these are unacceptable, by supplementing only relatively highly flavoured foods. This option will not usually be available with infants.

There is some evidence on the acceptability of type A FPC (General Oceanology, 1970a). Staple foods, fortified with FPC, have been found acceptable in large-scale trials, and although it is not universally accepted, FPC is generally considered to be successful in the treatment of protein malnutrition (Sidwell et al. 1969; FAO, 1969).

Much less data is available on the use of other forms of FPC. Dried fish powders with high flavour are very acceptable as condiments in many countries. Some trials have been made on the use of highly flavoured FPC in various forms of food but evidence of acceptability is scanty.

Technically, FPC can be added to a variety of foods at nutritionally suitable levels with minimum change in the characteristics of the food. However, ultimate consumer acceptability must be measured in each area and for each form of food, since it is unlikely that acceptability in one area can be taken to mean acceptability of the same food in another area especially if differing social and cultural structures exist.

In considering selection of a process for use in any area, it must be remembered that the products from different processes vary somewhat in properties, especially in colour, odour and flavour. It is, therefore, important to determine their acceptance by the intended recipients in the food to which they are to be added, at the proposed levels of use. For this purpose, the test FPC products used should be made on a pilot if not on a commercial scale using the species of fish proposed to be processed.

2.5 Utilization

There are two approaches to utilizing FPC, depending on whether type A or type B products are to be marketed.

Type A products (i.e. bland products) with no desirable functional properties can be marketed only as food additives, on the basis of nutritional value. They may only be marketable therefore, if they possess a lower production opportunity cost (the value of other materials which would have been produced as an alternative) or some other economic advantage over other materials, e.g. soy flour, which can achieve the same nutritional objective. The possibilities of this situation arising are covered in Section 5, dealing with the economic of production. Various methods of incorporating type **A** FPC in staple foods such as bread and pasta products have been reported (Sidwell et al., 1969).

Fishy flavoured type B products or edible fish meals must be marketed as forms of preserved fish rather than as general protein food additives. They could, for example, perform the same function as stockfish currently included in West African "draw soups", which are used to enhance the palatability of the staple diet of yams, cassava or sorghum porridge. The production of FPC of this type will, therefore, be dependent on the opportunity cost and other marketing advantages compared with other preserved fish products, taking into consideration the nature of the available raw material.

3. Resources

Analyses so far conducted (FAO, 1969) indicate that for production of FPC at a reasonable price, factory throughputs of the order of 200 tons per day of low-priced fish are required. However a process has not yet been established and analyzed sufficiently to determine whether process modification can reduce this economic minimum. In the present situation, FPC production would compete with conventional fish meal production for raw materials.

The resources already exploited and other potentially exploitable species are, in the main, pelagic and other shoaling species. Because of high concentrations of these fish, high catch rates are possible, resulting in relatively low catching costs.

3.1 Regional supplies of appropriate species, with future projections

By 1967 the total world catch of marine fish was 53.4 million tons. Pelagic species accounted for 25 million tons, of which 21 million tons was reduced to fish meal. In addition, 1.6 million tons of non-oily fishes were processed for meal (FAO, 1969).

Of the 1.6 million tons of non-oily fishes, 0.4 million tons was derived from waste fish from processing in the United Kingdom. Japanese catches accounted for some 0.5 million tons and, in the main, cod and hake catches accounted for the remainder.

The catches of oily fishes are dominated by the Peruvian/Chilean anchoveta catch of 10 million tons. Herring and mackerel catches accounted for about 7 million tons, mainly from the North Atlantic. About 2 million tons of pilchard, anchovy and horse mackerel were taken off South and Southwest Africa and Angola.

As indicated in the FAO Indicative World Plan for Agricultural Development, the potential yield of the marine fish resources has been estimated to be of the order of 100 million tons, not including mollusks (e.g. squids) and crustacea. The potential pelagic yield is estimated at 54 million tons. These figures are theoretical potentials and it would not be feasible to exploit all the stocks to their maximum sustainable level. The potential yield of some open ocean pelagic species, such as myctophids, is not included in these figures as no technique for economically harvesting them is yet available. There are also believed to be extensive resources of saury. These species may occur in very large quantities but are also very widely spread.

In practice, because of the difficulties of managing fisheries so that each species is fully exploited, it would not be expected that more than about 80% of the total potential of an area would be harvestable.

3.1.1 North Atlantic

In the North Atlantic, conservation action is under discussion for herring and mackerel stocks. In the short term, a reduction in yield of these species is expected.

The potential of the capelin fishery is uncertain. High variability in the abundance of the unfished stock has been recorded. Very high yields have been obtained in recent years with an intensive fishery, but the ability of the stock to withstand this is in doubt. At present, unexploited stocks of blue whiting and polar cod exist and expansion of fisheries on horse mackerel, sand eels, hakes and perhaps sauries is expected.

It would seem that no expansion in yield from the area can be expected and indeed the catch for conversion to meal might well be reduced in the near future.

3.1.2 Central Atlantic

The total catch from the Central Atlantic in 1967 was 3.6 million tons. Of this, 2.1 million tons came from the western half of the area (west of 40°W). The potential yields for the western and eastern areas are estimated at 5.5 million tons and 3.4 million tons respectively, somewhat more than half consisting of pelagic species.

Since these estimates were made, a considerable development in exploitation of sardinella stocks in the eastern area has taken place. Catches of the order of several hundred thousand tons have been reported. Until detailed statistics are available it is impossible to estimate the potential with precision.

Little-exploited stocks of anchovy and thread herring occur in the Caribbean area and the Gulf of Mexico. Pelagic stocks potential is given as 0.5 - 1 million tons in the Caribbean and about 1 million tons for the Gulf. In addition, in this latter area a potential yield of 0.1 - 1.5 million tons of demersal fish is possible, consisting of a wide range of species. An estimated catch of 0.6 million tons is already taken as by-catch in the shrimp fishery. Some of the species taken in these mixed catches may be poisonous and the incidence of occurrence of these should be examined prior to any development in the utilization of the by-catches.

3.1.3 South Atlantic

The recent catches from the South Atlantic region have amounted to about 3 million tons per annum. About 2.5 million tons were taken off the African coast and consisted of about 1.7 million tons of pelagic species, the remaining catch consisting mainly of hake. The pelagic catches consist of pilchard, horse mackerel and anchovy. In recent years there has been a decline in the catches of both pilchard and horse mackerel, while the anchovy catch has increased. With the advent of the recent increased effort due to the offshore fishing by factory vessels there is some concern that the stocks may not be able to sustain the present catch levels.

An estimate of the hake potential for the area has been given as 0.5 million tons, based on data obtained before the recent expansion in the fishery. Annual catches of this order have already been reached.

The Southwestern Atlantic region is generally underexploited. The major resources are anchovy (1 or probably several million tons), Falkland herring (perhaps 1 - 1.5 million tons), Poutassou and various other demersal species (1.5 million tons). These refer to the region off Argentina and Uruguay. Little is known of the potential off Brazil.

3.1.4 North Pacific

The North Pacific catch in 1967 was 6.4 million tons. The potential for the area is given as 10 million tons. There is still some potential increase in yield for some pelagic species (saury, Alaska pollock and sand eels). Others may be in need of conservation, which would imply a reduction in the near future compared to the present total catch.

3.1.5 Central Pacific

The western Central Pacific area includes very varied areas of shallow water where exploitation rates range from subsistence fisheries in the island areas to fairly heavily exploited regions off the Philippines, and in the Yellow and East China Seas. The Gulf of Thailand may be already overexploited for demersal species.

The total estimated catch in 1967 was 10 million tons. A potential yield for the area was estimated at 16 million tons, of which 4 million tons were shoaling pelagic species. These estimates are extremely rough. Due to the large shelf area the potential for the demersal fish catch per unit is thought to be rather low, and there is a wide variety of species.

The pelagic species are probably heavily exploited in the northern half of the area. In the southern area there may be a substantial resource, though distributed over a wide area.

A minimum catch of 0.7 million tons was taken in 1967 from the east Central Pacific. A pelagic fish potential yield of 4 million tons is estimated. Two million tons of anchovy could be taken off California and Mexico. The thread herring and anchovy resources off Central

America would support catches of about 1 million tons annually. The hake stocks off the west coast of the U.S.A. are estimated at 0.2 million tons potential annual yield. Trash fish catches in shrimp fisheries at present amount to about 0.3 - 0.8 million tons.

3.1.6 South Pacific

The present catches from the Southwest Pacific amount to about 0.4 million tons per annum, not including tunas. The potential is estimated at 0.6 million tons, though little is known of stocks in the area.

In the Southeast Pacific area 11 million tons, mainly of anchoveta, were taken in 1967. The hake catch from the area was 0.15 million tons. The anchoveta is fully exploited. Potential yields have been estimated as 0.2 million tons of hake, 0.2 million tons of grenadier and several hundred thousand tons of mackerel, jack mackerel and Falkland herring.

3.1.7 Indian Ocean

The 1967 catch from the Indian Ocean was estimated at 2 million tons, of which pelagic fish form a substantial part. Potential yields for the region are:

	Western	Eastern
Demersal fish	4.5 million tons	3.0 million tons
Shoaling pelagic fish	4.0 million tons	2.0 million tons

The distribution of the pelagic resources is patchy, with high stocks in the Arabian Sea and Gulf of Aden (sardines) and possibly off Indonesia. Some other areas may have low potential. Even in the high potential areas the localized distribution of the pelagic species may well be highly variable, as their availability is related to the effects of the monsoons.

3.1.8 Other resources

As stated, the above resources refer only to fish, and do not include cephalopods (squids), crustacea, etc. It is known that squid is abundant in several sea areas, but little is known about the potential of these resources. The total squid potential is guessed at probably over 10 million but less than 100 million tons. The squid potential of Peru is estimated at 0.5 million tons. The resources of common squid off the Japanese coast seem to be fully exploited at the present catch level of 300 - 500 thousand tons annually. The total world catch of cephalopods in 1967 was 1 million tons.

The resources of Antarctic krill are very large, with an estimated potential of over 50 million tons. Catching this krill in sufficient quantities presents difficulties, however, and the technology of catching and processing will have to be developed before industrial exploitation of this resource can materialize.

3.2 Seasonality considerations in fisheries

The duration of the period of high catch rates of different pelagic stocks is variable, depending on the particular migration, spawning and behaviour patterns of the species. For example, the sand eel fishery in the North Sea is limited to a period of about 8 weeks. On the other hand, as a result of improvements in fishing tactics the exploitation of the Atlanto-Scandian herring stock was extended from the immediate prespawn and spawning period of about 3 months to the whole year. Even though a species may be fished over a long period it is usual that peak catches occur at certain seasons. Peruvian anchoveta give high catch rates over about 4 months, but can be fished in reasonable quantities over another 5 months.

The seasons of abundance of the presently exploited species are well documented. In some cases, high catch rates may be maintained over a longer period of the year by switching the fishing operation from one species to another. The alternation of the exploitation of North Sea herring and mackerel by the Norwegian purse seine fleet is an example. On the other hand, in the South African fishery the various species appear to be caught at about the same period.

Relatively little can be predicted on the variability in catch rates of the presently unexploited resources. The Argentine anchovy is known to occur very close to the coast during several months from August on. Afterwards they migrate northeasterly towards the edge of the shelf. Fleets capable of following the migration have the opportunity of exploiting the stock over a great part of the year. Northern anchovy off California appear to be available for much of the year.

In the Arabian Sea the availability of the fish appears to be related to the monsoon period.

The hake stocks of Chile, Peru and Argentina appear to have a relatively limited migration. They could be exploited over a fairly long period by suitable vessels.

Sardinella stocks off West Africa are known to be sharply seasonal in abundance in certain regions. Present investigations in the area will provide information on the problem of availability.

The general seasonality in abundance of pelagic species means that the maintenance of input to factories will be to some degree dependent on the type of catching fleet. The dependence of a plant on the catches of a small-vessel fleet would make it more vulnerable to changes in availability of the fish due to migrations than it would be where the fisheries were exploited by large sea-going vessels. In fisheries development studies, an understanding of the seasonal changes in availability and distribution of the stock is essential for the proper planning of the utilization of the resource.

3.3 General considerations on resource supplies

At first sight the resource potential would appear to allow for a substantial further development of the fishing industry. However, when we examine the states of specific stocks it can be seen that many which have supported the industrial fisheries in recent years are fully or even overexploited. To maintain the present yield, fishing fleets must shift their efforts onto new resources. Many of the new resources are in distant waters or in remote areas. In some cases new techniques of capture may have to be developed. It might well be difficult to increase substantially or perhaps even maintain the present level of catch for meal production in the near future.

Where the utilization of yet unexploited resources is considered in plans for FPC production, the problems involved in simultaneously developing a fishing fleet, training fishermen, establishing shore facilities, establishing an FPC plant and developing a market for such a novel product will need consideration.

With the increase in world fish demand and the probable decline in the established supplies of fresh and frozen fish for human consumption in developed countries, an increased market for suitable alternative fish supplies may emerge. In view of the much higher value of such fish, diversion of supplies of, e.g. hake to this market would result in a reduction of supplies for FPC production.

Availability of raw material for FPC production may be influenced by more demanding care of the catch than is customary in normal fish meal production. In view of the better quality of the fish required, an alteration in vessels and equipment might be necessary, increasing the cost of prime material. A change in fishing tactics, such as the limiting of the effective areas of fishing, might also result.

PAG GUIDELINE 12 ON THE PRODUCTION OF SINGLE CELL PROTEIN FOR HUMAN CONSUMPTION

The following is presented as a general guide for producers on processes for and products from single cell protein (SCP). Because of the large number of potential organisms and processes, a complete description of any individual process is beyond the scope of this guideline.

1. Introduction

SCP may be looked upon as a food since it has a significant caloric and vitamin content in addition to protein. The nutritive value of the protein component is of particular importance if the product is to be used as a protein supplement. Although SCP processes may be inherently closer to chemical than to microbiological technology, it is strongly suggested that the traditional concept of "good manufacturing practice" be applied in the sense that it is currently used in the food industry. Plants and equipment should be of sanitary design and special care should be exercised in all aspects of processing, including raw material selection, quality control, sanitation, handling and packaging.

2. Types of organisms

Various classes of organisms have been considered as potential sources of SCP and appear to be capable of meeting the criteria established in this guideline. In general, it is preferable to select an organism of a species known not to produce pathogenic or toxic variants. Each organism eventually should be evaluated under the exact conditions proposed for industrial production.

3. Processes

3.1 Raw materials. Potential carbon sources include carbohydrate-containing materials (molasses, starch, cellulose, whey, sulfite liquor, etc.), various classes of hydrocarbons (methane and longer-chain normal alkanes), alcohols (methanol and ethanol) and carbon dioxide. In addition to the carbon substrate, other materials include sources of nitrogen, buffer salts, minerals, vitamins, air or oxygen, and chemicals such as antifoam agents, detergents and flocculants. No material should be introduced into the process which cannot later be removed from the SCP product if necessary to meet safety requirements.

3.2 Process variables. Operating variables of the fermentation such as temperature, air or oxygen supply, cell growth rate and cell concentration must be carefully controlled to ensure the required product quality and uniformity. The operations following cell production should also be monitored to ensure the required product quality and uniformity.

In general this will necessitate careful and continuous monitoring throughout the course of production and an understanding of the influence of these variables on the composition of the product.

3.3 Quality control. In addition to the quality control procedures associated with factors listed under "Composition", careful attention should be paid to the maintenance of the integrity of the original strain of the organism. An appropriate series of microbiological and biochemical tests should be worked out which serve both to demonstrate the stability of the organism and the absence of contaminants.

4. Safety evaluation

The procedure for safety evaluation is outlined in PAG Guideline No. 6, "Preclinical

Testing of Novel Sources of Protein". Following this testing, thorough clinical evaluation is particularly necessary because of effects such as allergenicity, uricogenesis, subjective responses and other reactions that can be determined only in humans.

5. Nutritional evaluation

The nutritional quality of the SCP is generally determined by the estimation of digestibility, biological value, and either net protein utilization or protein efficiency ratio in animals and by nitrogen balance studies in man. SCP generally contains nutrients other than protein and should be analyzed for these as well. Clinical testing should be carried out following PAG Guideline No. 7, "Human Testing of Supplementary Food Mixtures".

6. Composition

6.1 Protein. Crude protein (N x 6.25) should be determined routinely by N analysis. A constant conversion factor cannot be applied to total N to estimate true protein since it does not take into account such N-containing compounds as nucleic acids, amines, urea and ammonium citrate which may not contribute to protein nutrition. The complete spectrum of amino acids should be determined in the product as produced under conditions comparable to those of commercial operation and the ratio of essential amino acids to total amino acids should be calculated.

6.2 Nucleic acids (1,2).* Apart from toxicological considerations, there is a limitation to the amount of nucleic acids which should be introduced into human diets, because nucleic acid purines are excreted by man principally as uric acid. In susceptible individuals, elevated levels of serum uric acid increase the risk of gout and increased urinary concentration of uric acid may result in the formation of uric acid calculi.

The currently available information (3,4) suggests that there should be not more than two grams of nucleic acids per day introduced by SCP into the diet of an adult and correspondingly less for children, depending on their weight. Because of variations in the nucleic acid content of the biomass of different species, the nucleic acid content can be most usefully expressed as the ratio of nucleid acid nitrogen to total nitrogen (5).

6.3 Lipids. The solvent extract should be analyzed for the presence and content of triglycerides, steroids and phospholipids. If the ether extract is greater than a fraction of one per cent, the fatty acid profile should be determined by gas chromatography, with special reference to the presence and identification of fatty acids of unusual structure.

6.4 Ash. This should be analyzed for calcium, phosphorus, iron, iodine, alkali and alkaline earth elements and heavy metals.

6.5 Solvent residues. These should not exceed those compatible with good manufacturing practice. Methods of analysis are given in the 14th Report of the Joint FAO/WHO Expert Committee on Food Additives, FAO Nutrition Meetings Report Series No. 48, and WHO Technical Report Series No. 462, and accompanying monographs, including those for determining residues in foods.

7. Sanitary analysis

The microbial content should comply with the requirements specified in the relevant PAG Guideline.

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* Total nucleic acids should be determined by one of the methods recommended by Munro and Fleck (2).

References

1. Association of Official Analytical Chemists. 1965. Official methods of analysis. Tenth edition. AOAC, Washington, D. C.

2. Munro, H. N., and A. Fleck. 1966. Recent development in the measurement of nucleic acids in biological materials. The Analyst 91: 78-88.

3. Edozien, J. C. 1969. Yeast for human feeding, new data on safety. FAO/WHO/UNICEF Protein Advisory Group, United Nations, N. Y. PAG Document 2.23/1.

4. Calloway, D. H. 1969. Safety of single cell protein. FAO/WHO/UNICEF Protein Advisory Group, United Nations, N. Y. PAG Document 2.23/2.

5. Pokrovsky, A. A. 1971. Some results of biomedical studies on biomass of unicellular organisms. (In press).

PAG STATEMENT 18 ON RELATIONSHIP OF PRE- AND POSTNATAL MALNUTRITION IN CHILDREN TO MENTAL DEVELOPMENT, LEARNING AND BEHAVIOR

The PAG urges recognition of the fact that children experiencing severe malnutrition in infancy show not only permanently reduced physical growth and development but also impaired learning and behavior. The factors involved in the latter are both nutritional and social. Malnutrition beyond one year of age, including episodes of kwashiorkor, may also be associated with poor test performance during the school years and later life but this is believed to be due mainly to the social factors associated with the malnutrition rather than effects of nutrient deficiencies *per se*. Programs to ensure adequate nutrition for the preschool child can contribute to improved learning and behavior through their combined nutritional and social effects. This is one of the several reasons why programs to ensure adequate protein, calories and other essential nutrients for the preschool child should have such a high priority in nutritional planning and programs for national development.

As pointed out in the report of the Eighth FAO/WHO Joint Expert Group on Nutrition[*], recent research has also provided some new insights into the relationship of fetal nutrition to mental and physical development during childhood. After 26 weeks of gestation, fetal growth in developing countries tends to slow down and results in an increase in the number of "small-for-date" babies. These babies have greatly increased perinatal morbidity and mortality rates and suffer a high incidence of sublethal damage with long-lasting effects. In general, children born of malnourished mothers are more seriously affected by subsequent postnatal malnutrition. This fall in growth of the fetus in the last trimester of pregnancy can be prevented by adequate feeding of the malnourished mother. An adequate diet during lactation is also necessary to assure optimum breast feeding of the young child. The PAG endorses the following statement in the report of the FAO/WHO Joint Expert Committee on Nutrition (Geneva, 9-13 November 1970):

"Evidence has accumulated in the past dozen years that leads to the general conclusion that malnutrition in the first year of life, if severe enough markedly to retard physical growth and to necessitate admission to hospital, may cause mental impairment (1). If the deprivation is severe and prolonged and occurs during the first months of life, the retardation of brain development and function so produced may be so severe that it cannot be completely cured by nutritional rehabilitation. The lag in mental development is not restricted to the motor components of behavior. Problem-solving ability, language, personal-social development, general intelligence, intersensory integration, and perceptual visual competence are significantly below the level obtained by siblings or matched controls. When extra mental stimulation is provided during recovery the performance obtained is better, but usually not up to the normal level expected for the particular age (2).

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[*] FAO/WHO. 1971. Food fortification and protein-calorie malnutrition. Eighth report of the Joint FAO/WHO Expert Committee on Nutrition. FAO Nutrition Meetings Report Series No. 49; WHO Technical Report Series No. 477.

"The lower intellectual performance and inferior learning capacity found in survivors of severe malnutrition in early life must be seen in the context of the growing body of evidence on the vulnerability of the central nervous system to nutritional insults at critical periods of development. It has been shown in experimental animals that changes in the number of brain cells, in cellularity patterns, and in myelin lipids occur only when the animal is malnourished during the period of rapid growth, when the rate of cellular multiplication is close to its maximum. Permanent effects have been obtained under these conditions, even with moderate levels of food restriction (3).

"Although many non-nutritional factors that either accompany or precipitate malnutrition can themselves probably influence mental development, it is important to remember that the age of hospitalization for severe malnutrition early in life coincides with critical periods in behavioral development, which depends on an adequate environment and opportunities for acquiring experience. The effects of malnutrition on mental performance may; therefore, also reflect interference with the gaining of experience and the differentiation of behavior.

"At present, there are not enough data to identify the particular contributions of nutritional and non-nutritional factors to defective mental function following malnutrition. Both types of factor probably have effects that are independent but that interreact. Longitudinal studies, now in progress, should enable the differential effects of these factors to be assessed. The data so far available indicate that survivors of severe malnutrition in the first year of life frequently show low levels of intelligence and a low level of competence in learning basic skills."

References

1. Cravioto, J. & Robles, B. (1962) The influence of protein-calorie malnutrition on psychological test behavior. In: Mild and moderate forms of protein-calorie malnutrition. First Symposium of the Swedish Nutrition Foundation, Uppsala, Almquist & Wiksells, p. 115; Scrimshaw, N.S. & Gordon, J.E., ed. (1968) Malnutrition, learning and behavior, Cambridge, Mass., The M.I.T. Press; Cravioto, J., DeLicardie, E.R. & Birch, H.G. (1966) Pediatrics, 38, 319.

2. Yaktin, U.S. & McLaren, D.S. (1970) J. Ment. Defic. Res., 14, 25.

3. Dobbing, J. (1968) Vulnerable periods in developing brain. In: Davidson, A.N. & Dobbing, J., ed., Applied neurochemistry, Oxford, Blackwell Scientific Publications; Winick, M., Fish, I. & Rosso, P. (1968) J. Nutr., 95, 623.

THE GREEN REVOLUTION AND WORLD PROTEIN SUPPLIES*

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The Green Revolution, a shorthand expression used to describe the rapid spread of high-yielding varieties of wheat and rice in many developing countries, principally in Asia, has greatly altered the agricultural and food outlook over the past few years. The massive famine forecast for Asia has been averted, at least in the short run. The decline in per capita food production occurring during the early and midsixties has been arrested and in many countries reversed. Although uncontrolled population growth has blunted any pronounced nutritional improvement in most developing countries, recent agricultural achievements must be viewed against a backdrop of what the present situation would be in the absence of the Green Revolution.

The new "miracle seeds" have doubled yield per acre over those of local varieties wherever adequate water, fertilizer, and management is available. Since the protein content of the new seeds is essentially the same as that of the traditional varieties they replace, this means a doubling of the cereal protein supply as well. Where the Green Revolution technologies have permitted land to be double-cropped, the increase in protein output is even greater.

The exciting thing about the new seeds is that with a given amount of agricultural resources they permit production of a far greater amount of protein. With the traditional varieties, each additional pound of nitrogen fertilizer used seldom yielded more than 10 additional pounds of grain, but with the new seeds, each pound of additional nitrogen often yields an additional 10 to 20 pounds. Thus the new seeds may yield as much as 100 per cent more grain per pound of fertilizer applied than do indigenous varieties. They also produce perhaps 30 to 40 per cent more per man hour of labor than do traditional varieties. Because the increase in cereal production usually substantially exceeds the increase in water required by the new seeds, they also produce more protein per acre/foot of water. Thus for any given input the amount of cereal protein produced is greatly increased by the use of the new varieties.

Per capita cereal production trends

There is a tendency to evaluate the contribution of the Green Revolution by comparing trends in per capita cereal production of the past few years with earlier periods. What this approach overlooks is that the issue five years ago was not how rapidly can we improve our food situation, but rather, can we avoid famine? What the Green Revolution has done in several countries is to make it possible to maintain per capita cereal production in the face of relentless population growth.

The effect of the agricultural revolution on cereal production per person is shown in Table I. In Mexico, several consecutive record harvests add to some impressive gains, raising per capita cereal output far above the minimum required for direct human consumption. Since the grain available for conversion to animal protein more than doubled during the sixties, Mexico now has a solid resource base from which to develop a modern poultry and livestock industry.

This process is just beginning in Asia, but we can anticipate advances in at least some countries to match the Mexican performance. The break-through in cereal production in Asia is occurring first in wheat, as illustrated by the striking gains in both Pakistan and India. In these two countries, it is only beginning in rice, the number one staple, and other cereals.

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*A paper presented at the 19th PAG Meeting.

TABLE I. ANNUAL PRODUCTION OF SELECTED CEREALS IN COUNTRIES USING NEW SEEDS

(kilograms per person of total population)

	India		Pakistan	Ceylon	Mexico
	Wheat	Total foodgrains	Wheat	Milled rice	Total foodgrains
1960	24	178	40	61	212
1961	25	187	41	58	212
1962	27	183	43	64	232
1963	24	174	43	64	237
1964	21	169	38	64	264
1965	25	184	40	45	278
1966	21	144	32	56	281
1967	23	147	35	64	279
1968	32	184	51	74	258
1969	35	178	51	75	214
1970	36	183	53	80	258
1971	40	191	55(prel.)	n.a.	n.a.

Source: U.S. Department of Agriculture.

The countries achieving the greatest advances in rice production thus far are Ceylon, Malaysia and the Philippines.

Within Asia, Taiwan offers some helpful clues to the effect of rapid agricultural progress on income growth and diet. At present, average levels of protein and calorie intake in Taiwan are well above the minimum nutritional level. In rural areas of West Pakistan, wheat consumption is rising sharply as the new wheats spread and rice consumption is rising in parts of the Philippines countryside as the new rices are planted there.

In India, the early years of the Green Revolution had been counted on to return per capita foodgrain production to the levels of the early sixties. They are now much higher than they were five years ago during the drought period and with the 1970/71 harvest are moving to an all-time high.

In considering trends in per capita cereal production, we need to remind ourselves that we are dealing here with two variables, agricultural production and population. In this paper we are focusing primarily on the numerator in the food-population ratio but it is worth noting that a few encouraging signs are beginning to emerge on the population front. Mainland China, for example, the world's most populous country, appears to have significantly reduced its rate of population growth. Many observers feel it is now well below two per cent per year, though there are no solid data on which to base this estimate. The 1970 census in India turned up 15 million fewer people than had been projected, leading some to speculate that family planning might be slightly more effective than had been thought. If the preliminary data hold, it would indicate that India's average rate of growth during the seventies was 2.45 per cent annually. Other recent events in India, including the highly successful Ernakulam District family planning festival, in which more than 60,000 men were sterilized within a one-month period, and the nationwide liberalization of abortion provide a modest basis for hope. The 1970 census for Brazil indicates a population growth rate there of 2.8 per cent as compared with the earlier estimates of 3.2 per cent. In efforts to increase per capita food supplies and eliminate malnutrition, these latter developments may eventually figure much more prominently than is generally realized.

New opportunities for multiple cropping and diversification

Two genetic characteristics of the new seeds greatly enhance the possibilities for expanding cereal protein supplies. First, they are early maturing varieties, sometimes reducing the growing season by as much as one-third. Secondly, both the new rices and the new wheats are much less sensitive to day length than are traditional varieties. This gives much greater flexibility in planting time for the new seeds, particularly rice, which is in sharp contrast with traditional seeds whose biological clocks are keyed to a specific day-length cycle. The combination of early maturation and reduced photo-period sensitivity gives much greater flexibility in multiple cropping where the necessary water supplies are available.

With the new seeds, farmers in the tropics are beginning to discover the potential for expanding food production in the dry sunny season. Data for both Indonesia and the Philippines show higher yields in dry seasons than in the wet seasons for five high-yielding varieties grown at several different sites. Although environmental conditions varied widely at the experiment station sites, dry-season yields were consistently higher, averaging 52 per cent above those during the wet season.

The much greater yield potential of the new varieties reduces the share of agricultural resources needed to produce food staples to meet a given level of consumption, releasing land for the cultivation of vegetables or for feed crops to boost livestock production. In several Asian countries the production of food grains is expanding more rapidly than population growth and demand, as witness the declining importance of food imports in such countries as India. The inelasticity of demand for food staples will make overproduction in many situations less profitable and thus act as an incentive to increase oilseed, pulse, vegetable, feedgrain and livestock production.

Although the recent expansion of multiple cropping and diversification of agriculture in Taiwan following the adoption of improved cereal varieties predates the Green Revolution, it does indicate the path which agricultural development may follow in developing areas. As farmers adopted improved rice varieties and planted more crops per acre, cereal production rose steadily and land productivity climbed 300 per cent between 1950 and 1965. The potential for multiple cropping is suggested by the diligence of the Taiwanese farmers who expanded the multiple-cropped area from 18 per cent of the total cropland in 1946 to 89 per cent in 1966. In the last half-century, acreage of cultivated land has grown by only 26 per cent, but crop area has nearly doubled, and while the farm labor force has risen by one-third, the harvested crop area per laborer has actually increased. By 1969 Taiwanese farmers were harvesting an average of two crops per year, some as many as four crops annually. With its intensive cropping Taiwan is an exporter of rice; limited to single cropping it would be heavily dependent on imports.

Patterns of production have changed quite radically in the last decade. Sugarcane, which accounted for 80 per cent of Taiwan's total exports in 1950, had declined to only seven per cent of the total by 1967 and banana exports, primarily to Japan, amounted to 10 per cent. During the sixties, while rice production rose only slightly (22 per cent) to meet domestic demand and sugarcane actually declined in production (24 per cent), fruit and vegetable production more than doubled.

If other developing countries take advantage of the full benefits of the new seeds, their agricultural development may follow a course similar to that of Taiwan, which is now rapidly diversifying farm production and exporting large quantities of both fresh and processed fruits and vegetables to the United States and

Canada.

In the short run there is a possibility that the greatly increased profitability of wheat and rice will thwart diversification, particularly in cereal deficit countries. Where farmers invest in the capital inputs necessary to reap the full benefits of the new seeds they will undoubtedly want to cultivate the most productive crops in order to recover the costs of the inputs. Perhaps the most critical danger is that land may be shifted out of pulse and oilseed cultivation, thus reducing the availability of these low-cost, high-quality proteins.

Competition between cereals and pulses

In a study of foodgrain production in India, it was found that pulse production remained static while rice production increased modestly and wheat more than doubled during the past decade. In per capita terms, pulse availability declined by more than one-fourth during the sixties while rice remained about the same and wheat availability increased by one-fourth. (See Table II). For the majority of the population for whom pulses are a major source of quality protein this implies a significant decline in nutrition. Both the failure to develop improved pulse varieties and an agricultural price policy which did not encourage pulse production apparently contributed to the decline.

Even more dramatic was the shift in production patterns in the Punjab, the state in which the Green Revolution has had the greatest impact and which is a major food supplier for the entire country. Not only did total production of pulses decline, but acreage fell by one-third or more. At the same time wheat acreage increased by about 50 per cent. How much the increase in wheat acreage is due to double-cropping and how much is directly attributable to a shift from pulse cultivation has not been calculated, but undoubtedly both have contributed.

It would be wrong to blame these trends solely on the spread of the new seeds, since the decline in pulse production predates the

TABLE II. INDIA : PRODUCTION OF RICE, WHEAT AND PULSES

Year	Total (million metric tons)			Per person (kilograms)		
	Rice, milled	Wheat	Pulses	Rice, milled	Wheat	Pulses
1961	35.9	11.0	12.7	81.8	25.1	29.1
1962	32.1	12.1	11.8	71.6	27.0	26.3
1963	37.1	10.8	11.4	80.5	23.5	24.8
1964	39.2	9.9	10.1	83.7	21.0	23.0
1965	30.8	12.3	12.4	64.0	25.4	26.8
1966	30.6	10.4	9.8	62.0	21.1	19.8
1967	37.8	11.4	8.3	74.4	23.4	16.3
1968	40.0	16.5	12.1	76.4	31.6	23.2
1969	40.6	18.7	10.4	75.7	34.8	19.4
1970	42.8	20.1	11.7	77.0	35.7	21.1
1971 (prel.)	44.0	23.2	11.6	77.5	40.0	20.4

Source: U.S. Department of Agriculture.

Green Revolution. In India, an even more pronounced decline in pulse production might have occurred in the absence of the Green Revolution if the increase in population had forced an even greater emphasis on wheat and rice production in order to fulfill basic caloric needs. In some areas of India where the Green Revolution has stimulated land improvements with increased water and fertilizer inputs, pulse yields have increased by about 30 per cent.

Within Mexico, the breakthrough in cereal production, largely confined to wheat, has not adversely affected pulse production at all. Indeed, the production of dry beans, Mexico's principal pulse, has expanded far more rapidly than most crops, closely paralleling the explosive increase in wheat production. (See Table III.) In light of this one might ask whether the failure of pulse production to expand in India is more a result of the breakthrough in cereal production or of a lag in pulse research and mismanagement of agricultural price policy.

TABLE III. MEXICO: PRODUCTION OF WHEAT AND DRY BEANS

	Wheat	Dry beans
	(million tons)	
1960	1,190	600
1961	1,402	617
1962	1,502	633
1963	1,703	700
1964	1,900	892
1965	2,088	903
1966	1,609	1,002
1967	2,058	1,008
1968	1,793	1,056
1969	2,000	833
1970	2,100	1,100

Source: U.S. Department of Agriculture

What is needed in India are comparable efforts to improve pulse and oilseed varieties to increase their yield so that production will be equally profitable. During the interim, a strong case can be advanced for using price policy to encourage the expansion of pulse production relative to cereals. Perhaps the best model for this is the United States, which has used price policy to help expand production of soybeans relative to cereals, particularly corn, yields of which have risen rapidly and which compete directly with soybeans for land. Nevertheless, over the past 15 years, production of soybeans has tripled, rising from 374 million bushels in 1955 to 1.2 billion bushels at present.

Livestock production

As countries increase per capita cereal availability to the point where it exceeds the demand for direct consumption, it provides a basis for expansion of livestock production. This pattern of development seems to be common not only to industrial countries but to developing ones as well. In Taiwan, for example, livestock production has expanded far more rapidly than crops in recent years, as Table IV clearly indicates. Between 1966 and 1970 livestock production increased more than 9 per cent annually. While livestock accounted for less than one-fourth of aggregate food production in 1966, by 1970 it accounted for nearly one-third This expansion, primarily in pork and poultry, has undoubtedly

TABLE IV. TAIWAN: INDICES OF PRODUCTION 1965 - 1970

	Crops	Livestock
1965	100.0	100.0
1966	101.7	102.4
1967	105.0	117.7
1968	108.5	122.9
1969	103.8	131.5
1970	104.4	145.0

Source: U.S. Department of Agriculture

led to an increase in domestic protein consumption, and has met the change in consumers' tastes as income levels have risen. In addition to this, diversification has opened new possibilities for exports, particularly of pork to Japan.

A review of Mexican agriculture over the past decade also shows a close correlation between grain production increases and subsequent livestock production increases (See Table V).

TABLE V. MEXICO : INDICES OF PRODUCTION (1963 - 1965 = 100).

	Crops	Livestock
1963-65	100	100
1966	110	107
1967	110	108
1968	128	129
1969	116	135
1970	129	142

Source: U. S. Department of Agriculture.

The new high-yielding wheat varieties have boosted Mexico above the minimum grain requirements so that more grain can be used for production of livestock.

However, in most developing countries with rapidly growing population and widespread poverty, animal protein is beyond the purchasing power of the masses and is too expensive and inefficient to be a feasible means of improving general nutrition in the short run. In Guatemala, for example, widespread protein deficiency exists although 10,000 tons of meat products are exported every year because domestic demand cannot compete with world market prices. In fact, livestock production, which caters to a very small, high-income sector, may be diverting land and other resources away from pulse and oilseed production which in most poorer nations are the major sources of protein for the general populace. A similar situation exists in Peru where widespread protein malnutrition coexists with the export of vast tonnages of fish protein.

Income levels and distribution

The Green Revolution affects protein intake in two important ways. First and most obvious of these is the effect on the supply, but second and perhaps more important, it introduces new efficiencies into the economic development process which permit more rapid economic growth. This is important because most people now agree that malnutrition is inseparable from poverty itself. Even in the United States where there is poverty, there is often protein malnutrition. In the developing countries of the world, the connection is impossible to ignore. The world food budget shows that the 1.1 billion people living in adequately-fed countries in 1960 had an average yearly income of US$1,070 per person; the 1.9 billion living in malnourished countries had an average income of $97. The surest way to improve nutrition quickly is to raise incomes dramatically and diets improve most rapidly where per capita incomes are growing fastest.

It is essential that we understand this link between purchasing power and protein intake. Some developing countries such as Mexico, Kenya, Iran, the Philippines, Pakistan and India have reached self-sufficiency in some or all cereals. However, this is economic self-sufficiency, i.e. internal production equals or exceeds the amount the domestic market will absorb at prevailing prices. This should not be confused with nutritional self-sufficiency which infers that purchasing power is strong enough to satisfy nutritional needs. Some countries such as Mexico and India, for example, have achieved economic self-sufficiency but still have widespread malnutrition. Others are not economically self-sufficient but income is such that relatively little malnutrition exists. Taiwan is the classic example of this, where wide participation in the development process has allowed a rise in the general standard of living while still at a low average per capita level of income.

The impact of the Green Revolution on income levels and distribution may therefore be as important as its impact on production levels and trends. Unfortunately, little definitive analysis has been done in this area. To the extent that the Green Revolution has raised rural income relative to urban incomes, it has contributed toward ironing out income disparities. There has been much talk, particularly in the popular media, of the problems of the distribution of benefits of the Green Revolution, much of it not well founded. Most often discussion focuses on the distribution of benefits according to size of farm, but the more important factor affecting the distribution of Green Revolution benefits is geographical. Those areas which have adequate water supplies quickly adopt the Green Revolution technologies, while those areas which do not have adequate water are not able to, almost regardless of farm size. Within India, the Punjab with its well-developed irrigation system, has benefitted greatly from the new farm technologies, but the dryland farming areas remain largely unaffected. Within Turkey, the new wheats have been widely adopted on the high rainfall coastal areas, but they have had little impact on the Anatolian Plateau where most of the country's wheat is produced. This is not to say that farm size is not a factor affecting the adoption of the Green Revolution technologies; other things being equal, large farmers are usually better equipped to command the needed inputs.

Those regions of the country which have the most productive land, and particularly where a high proportion of land is already under irrigation, are the areas which have experienced the most rapid adoption. Thus those who were already favored were able to take the greatest advantage of the new technologies. This has perhaps been more pronounced in Mexico and Pakistan then elsewhere.

The example of East and West Pakistan illustrates well the geographical selectivity of the Green Revolution technologies. It is difficult to conceive of any region better suited to the new seeds than West Pakistan, with nearly all its farmland under irrigation. Per capita cereal availability has risen so dramatically that the effects must be seeping down to even the lowest income levels. East Pakistan, by contrast, dependent on monsoon flooding of its rice fields, is ill-suited to the new seeds and has been unable to participate meaningfully in the Green Revolution. Even with a great increase in imports from West Pakistan, per capita availability of rice and wheat have fallen since 1960. The great disparity in the agricultural and food outlook in the two sectors, as shown in Table VI, answers the question of what would have happened in the absence of the Green Revolution.

Taking the example of Mexico, where the yield take-off began in the early fifties, evidence indicates that income distribution may be less equitable following the introduction of high-yielding varieties. In a study of income distribution, it was shown that the ratio of the per cent of total income received by the top 20 per cent of the population to the bottom 20 per cent increased from just under 10 in 1950 to 17 in 1963. Thus in relative, if not in absolute, terms the bottom fifth of the population was worse off in 1963 than in 1950. Although some of this group would be within the urban sector, the great majority was undoubtedly found within the rural population where the new technologies had not penetrated.

The inadequacy of such traditional indicators as average per capita income, aggregates of production and per capita availability of commodities in assessing living standards is revealed by such studies. National development may not translate into a rise in the general standard of living unless there is a broad participation in economic development. A comparison of Mexico and Taiwan gives ample testimony. In Mexico, where per capita income is about $500 per year, development has not been uniform and poverty and malnutrition are still prevalent. In Taiwan, by contrast, with a per capita income of only $200 per year, there is very little malnutrition.

TABLE VI. PAKISTAN: PRODUCTION, NET TRADE, AND AVAILABILITY OF WHEAT AND RICE COMBINED, JULY - JUNE 1960/61 THROUGH 1969/70

Year beginning July	Production	Net trade	Availability	Available per capita	Index of per capita availability (1960/62=100)
	. . . .	million tons	. . . .	kilos	
			West Pakistan		
1960/61	4.83	.66	5.49	115)	100
1961/62	5.21	.46	5.67	117)	
1962/63	5.27	.30	5.57	112	96
1963/64	5.45	.57	6.02	119	102
1964/65	5.60	1.38	6.98	136	117
1965/66	5.25	.27	5.52	105	90
1966/67	5.69	.66	6.35	119	102
1967/68	7.92	1.17	9.09	167	144
1068/69	8.62	-.48	8.14	146	126
1969/70	9.40	-.50	8.90	156	134
			East Pakistan		
1960/61	9.70	.69	10.39	199)	100
1961/62	9.66	.39	10.05	186)	
1962/63	9.92	1.45	11.37	203	106
1963/64	10.65	1.07	11.72	202	106
1964/65	10.53	.34	10.87	181	95
1965/66	10.59	.88	11.47	185	97
1966/67	9.64	.98	10.62	165	86
1967/68	11.23	.91	12.14	183	96
1968/69	11.30	1.12	12.42	183	96
1969/70	11.60	1.70	13.30	190	99

Note: Net trade for East and West Pakistan reflects shipments between the two areas, mostly shipments of rice from West Pakistan to East Pakistan. Minus sign indicates net exports by West Pakistan.

The per capita use of rice and wheat combined in East Pakistan was about two-thirds more than in West Pakistan during the early 1960's, and it is currently about one-fifth higher. West Pakistan's calorie intake continues to exceed East Pakistan's because of greater use of foods other than rice and wheat.

Summary

One of the principal difficulties we face in the food-population-environment area is asking the right questions. For example, as indicated earlier, the appropriate question in evaluating the Green Revolution is not has food production increased more rapidly since the Green Revolution, but rather, what would the trend in per capita food production have been in the absence of the Green Revolution?

As we begin to press against the constraints of our finite ecosystem, we realize that the question is no longer simply can we produce enough food, but the much more complex one of how can we produce enough food within the constraints of our finite ecosystem? Signs of agricultural stress on the ecosystem are becoming increasingly abundant, including such things as eutrophication of fresh water lakes and streams, the threatened extinction of numerous species of birds, fish and mammals, and the possible modification of climate through agricultural activity.

In looking at the food-population relationship we have frequently asked ourselves how we can expand food production more rapidly, but have only recently considered how we can slow population growth enough to achieve adequate nutrition. The historical evidence indicates that despite the several hundred-fold increase in the annual production of protein since the invention of agriculture, much of mankind still suffers from malnourishment. Few if any countries have achieved nationally adequate levels of diet with rapid population growth rates such as those characterizing most of the developing countries today.

There is little doubt in my mind that we will have to pay much more attention to the population variable in order to solve the malnutrition problem. We may also eventually find it necessary to seriously consider a lower level on the food chain for the rich countries (more cereals and less meat) in order to free resources for food consumption in the poor countries. Traditionally, we have assumed that the oceans offer an untapped reserve of protein to meet future food needs and that the world fish catch, now just under 60 million tons, would eventually reach at least 100 million tons and perhaps 200 million tons. Unfortunately, in 1969 the total world fish catch dropped three per cent or five per cent worldwide in per capita terms. Preliminary data for 1970 indicates a further reduction. Given this possible leveling off of the supply of marine protein, we may be forced to rely on conventional agriculture even more than in the past.

In summarizing the role of the Green Revolution as it relates to nutrition, I would say that the Green Revolution technologies bring exciting new possibilities for improving the well-being of literally hundreds of millions. Indeed, it is quite likely that the new seeds may affect the well-being of more people in a shorter period of time than any previous technological advance in history. This is not to say, however, that the Green Revolution is a panacea. At best, it provides a bit of breathing space in which to devise more effective ways of slowing and eventually stabilizing population growth. Without this, the prospects of achieving adequate protein nutrition in our finite ecosystem are dim indeed.

THE USE OF FERMENTED MILK IN INFANT FEEDING IN THE U.S.S.R.*

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Fermented milk of various kinds, mostly cow's milk, has been extensively used for infant and toddler feeding in the U.S.S.R. since the early 1930's. In fact, cow's milk acidified by fermentation is the principal weaning food product, as well as a food for nonbreastfed infants. Although data are not available, it would be safe to estimate that the output of fermented milk products by milk kitchens** is much higher than that of fresh milk.

The preference given by pediatricians and nutritionists to fermented products in infant feeding is based on a number of considerations well supported by rather extensive research data of the 1930's and 1940's. Without presenting details of these data an attempt will be made to summarize them in the following paragraphs.

In most of the areas of the U.S.S.R. fermented milk products of various types had always been in wide use by agricultural populations both for adult and for children's feeding. Types of fermentation and the strains of microorganisms used for fermentation differed from place to place according to local customs and conditions and the predominant ambient temperatures. At present, along with home fermentation of milk, industrial production of fermented milk is being undertaken on a large scale and cities are supplied with the required quantities of bottled acidified milk products of some 6-8 varieties. Commercially available yogurt, kefir, acidophyllin, koumiss, etc., are very popular and are used extensively by adults and children from the third year of life on. Younger children and infants are provided with fermented milk products through the network of milk kitchens, as mentioned above. The popularity of fermented milk products, however, is not the main reason for their use in infant feeding.

Acidification of milk by fermentation does not change substantially the composition with respect to principal nutrients. However, it brings about certain changes which have been proven to be of benefit for digestion, particularly for infants. As a result of fermentation the content of milk acid increases (up to around 1% in products recommended for infants) and this, along with a certain degree of enzymatic proteolysis (peptonization), stimulates gastric secretion. The stimulating effect of fermented milk on gastric juice production is almost equal to that of meat broth (1). Observations in infants showed also that production of saliva, bile and pancreatic juice by acidified milk stimulation is more active than that caused by fresh milk.

In the presence of milk acid, casein gives finer coagulated particles which are more accessible to gastric proteases. This, along with the occurrence in fermented milk of proteoses and peptones (about 0.45% in 48-hour-old kefir) due to partial hydrolysis during fermentation, renders the proteins of such products more digestible than fresh milk proteins. Special studies showed that retention of nitrogen, phosphorus and calcium, as well as iron and fat, is higher on kefir feeding than on fresh milk (2). In the presence of acid, water-soluble vitamins are better preserved than in fresh milk. As a result of the microbial and yeast activity during fermentation, the content of B-group vitamins (thiamine, riboflavin, B_{12}) increases considerably and enriches the product. The above nutritional considerations show that fermented milk products have definite advantages for infant feeding. This is true not only for healthy children, but also for infants with various diseases, in particular diarrhea and malnutrition which impede gastric secretion. The majority of Soviet pediatricians prefer, therefore, the use of fermented milk products both in health and disease.

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* A background paper for the third meeting of the *ad hoc* Working Group on Feeding the Preschool Child.

** Milk kitchens are special institutions which produce and distribute all kinds of milk and other products for infant and toddler feeding on pediatricians' prescriptions. There are at present over 6000 of them in the U.S.S.R., catering to practically the entire population under 2 years of age.

There are, however, other considerations in favor of the use of fermented milk. Such products possess antimicrobial properties and store better. Numerous studies indicate that acidification prevents to a considerable degree the growth of many pathogens, among them E. coli, typhoid and salmonella organisms. In addition, it has been shown that certain strains of milk yeasts and B. acidophyllus produce antibiotic-like substances, nizinum among them, acting bacteriostatically (in concentrations of 1:800) or even bacteriocidally (in concentrations of 1:400) on typhoid and tuberculous organisms (3, 4). Due to these properties, developing in the process of fermentation, the growth of pathogens may be suppressed. Interaction of different strains used for fermentation in some products, particularly in kefir, renders the reaction of acidification self-arresting to a certain degree. Therefore, the ripe product may be kept for a period of time without losing its quality. Thus the kefir used normally for infants (after 48 hours of fermentation) can be kept for an extra day at ambient temperature.

Milk products for infant feeding are prepared from pasteurized milk and issued in small bottles containing the prescribed quantity for one meal for one day. Up to 5% of sugar is usually added to improve palatability. For very young infants mixtures of 2/3 fermented milk and 1/3 rice or oat broth are made. For fermentation, a stock ferment is used which is subject to thorough bacteriological control. Dried ferments of different types are available, which simplifies the preparation of stock solutions.

In considering the comparative merits of fermented milk products one can argue that dried infant food mixtures are more convenient for use by families. It may be so in some instances, but one should remember that for the population as a whole the production of dried mixtures may not be economically feasible (as for instance in developing countries) or acceptable (particularly for those who value natural milk products most, as is the case in most areas of the U. S. S. R.). For a distribution pattern based on a wide network of milk kitchens as in the U. S. S. R., the extra work in preparing fermented products is well justified by their simpler storage and higher safety.

The most popular product among fermented milk preparations in the U. S. S. R. is kefir. Its ferment, developed from naturally-occurring cultures from acidified milk in the North Caucasus, is a symbiosis of milk yeasts Torula kefir with Streptococcus lactis, Streptobacteria plantarum and a number of other acidophyllic organisms. Fermentation in loosely corked bottles prevents formation of alcohol, the content of which in infants' products does not exceed 0.025%. In southern regions some local strains of ferment are used, mainly those requiring a higher temperature for fermentation. Studies of these strains indicate their value in particular conditions; among them mazzoni, fermented milk used in the Caucasus, is most popular. Buttermilk, acidophyllin and some other products are used mainly as diets in certain nutritional disorders. For protein enrichment of food, finely coagulated milk protein can be easily obtained from kefir by simply straining the liquid from it through cloth or gauze. It can then be added to kefir, increasing its protein content without enlarging considerably the quantity to be consumed. Most of the infants quickly get used to kefir and very few reject the product; in fact, rejection of fresh milk is more common. In view of the U. S. S. R. experience, fermented milk products may be recommended for infant feeding in areas where there are similar facilities for liquid milk distribution.

References

1. Kasjanenko, I. 1959. Vrachebnoe Delo 9:907.
2. Olevsky, M. 1947. Bull. Exp. Biol. Med. (U.S.S.R.) 23:14.
3. Polonskaja, M. 1952. Mikrobiologia 21:303.
4. Skorodumova, A. 1958. XIV International Congress of Milk Industry. Moscow, U.S.S.R.

NUTRITION REHABILITATION CENTERS: AN EVALUATION OF THEIR PERFORMANCE

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The following is a summary, prepared by the authors, of a background document presented at the 19th PAG Meeting. The complete paper will be published in a professional journal at a later date.

In several countries Nutrition Rehabilitation Centers have been established as a means of preventing and alleviating childhood malnutrition. Evaluation reports on the effectiveness of centers are limited.

Published data on one pilot center each in Uganda, Peru and Haiti are available and unpublished reports exist concerning several centers in Guatemala. In general, the data suggest that children attending centers for several months do show improved growth, and therefore nutrition recuperation is being achieved in an impressive percentage of the small number of children at risk attending such centers. A major objective of centers is educational, and there are few data to judge the benefits resulting from the nutrition and health educational features of the programs. In Uganda and Guatemala where this aspect was partly evaluated the results reported are disappointing and inadequate. In Haiti the pilot center at Fond Parisien is reported to have reduced serious malnutrition in the community.

A clear need was seen for more objective evaluation data not only of progress of children while attending the centers but also on how these children progress at home in the months and years after discharge from the centers and on the knowledge and practices of mothers who have participated in the center programs.

A study of seven centers in Haiti and nine in Guatemala was undertaken, using a population of approximately 400 children who fitted unevenly into "experimental" and "control" groups. The experimental group consisted of children who could be located in the community who had attended a center for at least 2 months (the mean was 4.5 months in Haiti and 6.4 months in Guatemala). The control children were found in the same way but had attended the centers for less than a month, and most of them for only a very short time.

The results showed that the experimental and control groups had many similar characteristics and that their weight for age was not different at the time they were first seen at the center. At the time of discharge from the center the experimental group in both countries showed a significantly higher weight-age than on admission.

The children in both the experimental and control groups were located and seen by us approximately one year after their discharge from the center. They were weighed and measured, and a questionnaire was completed for each mother. Data were obtained for children in the experimental group at "admission", "discharge" and "follow-up" and for children in the control group at the time of "admission" and "follow-up". The mean weight-age of the experimental group in each country had not improved during the year since they had left the center. In Haiti the children in the experimental group had a significantly higher weight-age than did the control group at the time of follow-up. Disappointingly, this was not the case in Guatemala. The mortality among the experimental group was much lower than that among the control group in both countries (4% and 14% respectively in Haiti, and 1% and 9% respectively in Guatemala), although because of small numbers these differences are not statistically significant.

An evaluation of dietary practices, nutritional knowledge of mothers and disease incidence showed some differences, but not much that was consistent or striking. The direction of change was usually in favor of the experimental group. Using sociological means, certain hypotheses were tested and rejected on the grounds that no difference could be found. These hypotheses included the notion that centers functioning at a lower level of structural differentiation, that were more integrated into the community and where there was more involvement of mothers, would produce better results.

Certain economic factors were investigated and some cost-benefit figures determined. The mean center cost per child per day was $0.372 in Haiti and $0.876 in Guatemala. Hospitalization in Haiti is $12.00 per person per day and is $7.31 in Guatemala. In Haiti the cost per child with a mean stay of 6.4 months was about $72 and in Guatemala with a mean stay of 8 months was about $214. Benefits were determined using a number of parameters. If for example it is considered, as our data suggest, that 75% of center children improve their weight for age between admission and discharge, then the cost per child benefited rises by 25%. However, if the improvement of experimental over control children in each country is calculated in terms of the benefits of experimental children who progressed minus the percentage of control children who progressed, then the cost of recuperating one child soars to $604.00 per child in Haiti and $2671.00 in Guatemala.

The conclusion can be reached that Nutrition Rehabilitation Centers are, in general, having a favorable effect on the growth of a majority of children while they are being regularly fed at the center, but that they are having a rather small effect on these children after they return home. The reasons for this are probably several and many can only be surmised.

It is evident that in the centers included in this study the education of mothers is not as effective as might be hoped. This is probably because (a) much more attention by staff is given to feeding and caring for center children than to education of their mothers; (b) the nutrition and health education is often unrealistic in terms of what is feasible in the homes (i.e. too much stress on animal protein sources rather than legumes) and (c) a significant proportion of families using the centers are too poor to make the necessary improvements in the diets of their children.

Recommendations for improvement include a greater emphasis on nutrition education with stress being placed on locally available protein-rich foods such as legumes and development of a system of regular follow-up of children discharged from centers such as for example the welding of an under-five clinic onto each NRC.

Geneva, Switzerland

REPORT OF JOINT FAO/WHO EXPERT COMMITTEE MEETING ON FOOD FORTIFICATION AND PROTEIN - CALORIE MALNUTRITION*

The Joint FAO/WHO Expert Committee on Nutrition met in Geneva from 9 to 18 November, 1970. The Session was exclusively devoted to a discussion on two important topics - the role of food fortification programme within the context of the overall food and nutrition policies and the problem of protein calorie malnutrition (PCM).

Food Fortification

The report defines the term fortification as follows:
"Of the names in current use in various parts of the world, the Committee considered the term fortification to be the most appropriate to describe the process whereby nutrients are added to foods to maintain or improve the quality of the diet of a group, a community, or a population".
In adopting this definition, the report makes clear that in general "fortification" relates to the use of relatively small quantities of additives.

There are several approaches to the solution of nutrition problems and the role to be assigned to food fortification in the overall nutrition policy of a country is determined by several factors some of which relate directly to other aspects of national policies, such as development of agriculture, food industry, etc. Hence, the final decision on food fortification must be made at the national level as part of the national food and nutrition policy.

After a brief review of the experience in food fortification, from past and present programmes, the report discusses at length the design of a fortification programme, with emphasis on definition of nutrient needs and target groups, choice of carrier food and level of fortification, evaluation of benefits, technological considerations, economic aspects and legislative and control measures.

Iron, vitamin D and protein and amino acids are discussed separately as nutrients requiring special consideration. In view of the uncertainty about the physiological availability of various iron preparations used in current iron fortification programmes, the report recommends that research into effective methods of iron fortification should be given priority attention. Though the toxic effect of excessive intake of vitamin D has been known for a long time, it was only after the outbreaks of hypercalcemia in infants in the United Kingdom that the likelihood of the amount of vitamin D in fortification programmes causing toxic effects was taken note of. The report discusses the significance of these observations in relation to the still continued occurrence of rickets in appreciable numbers in infants and concludes that "because of great differences in the severity of the problem and in the available effective vehicles suitable for fortification, the appropriate decisions must presumably be made upon a regional or country basis, considering both the need and dangers of excessive levels of vitamin D intake." On amino acid fortification, the report has referred to the PAG Statement No. 9 on the subject and has agreed with the views expressed therein.

While drawing attention to the special and unique problems of the developing countries, which represent a very wide spectrum varying in size, population density and distribution, natural and financial resources, climate, agricultural and technological systems and potentials and the general cultural pattern, the report notes "the acute shortage of personnel trained in food science and technology . . . and the efforts being made in many countries to establish food science departments in universities and associated institutions and courses in food processing in technical and other colleges. It is clearly of importance that provision should be made for teaching of nutrition in these departments of food science and technology". It is recommended that the international agencies should give increased support to such development.

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* FAO Nutrition Meetings Report Series No. 49; WHO Technical Report Series No. 477.

Protein-calorie malnutrition (PCM)

The report reviews the large body of new information which had accumulated on the etiology, treatment and prevention and also the sequelae of PCM with their socioeconomic implications.

Since the term protein-calorie malnutrition had the merit of wide usage it was decided to retain the term for the time being. However, it is emphasized that the concept of PCM should include also the mild and moderate protein-calorie malnutrition in the community since they are more widespread and of great public health importance. The difficulties of classification of PCM is noted and it is recommended that for field work the emphasis should be on recording of basic data such as age, weight, height and presence of edema along with birth weight wherever available and a record of the other clinical signs including evidence of other nutritional deficiencies. In clinical studies, however, in centres where facilities for detailed investigations are not available, the use of a simplified scheme of classification based on body weight, height and presence of edema, is recommended.

The point prevalence of severe cases of PCM in a few surveys conducted in communities around the world for 1966 to 1969 was found to range between 0 and 7.6 per cent in children below 5 years. On the other hand, the prevalence of moderate cases of PCM assessed using Gomez classification was found to be between 4.4 and 43.1 per cent. The information regarding prevalence is inadequate and from the available data, it is difficult to provide even a rough estimate of total number of malnourished children in the world. There is a great need for accurate information and field studies undertaken in future should adopt uniform criteria for recording, grouping and reporting of data and also should be planned on a sound epidemiological and statistical basis. Data from point prevalence studies should be supplemented by information from longitudinal studies. It was recommended that WHO and FAO should examine the feasibility of developing and adopting standards for heights and weights for international use.

The value and limitation of the indirect indicators such as age and disease, specific death rates and data on morbidity from childhood illnesses for estimation of the magnitude of the problem of PCM were discussed.

The rapid industrialisation and urbanisation taking place in many developing countries have resulted in profound changes in the economy and pattern of living of a large segment of the population, bringing in its wake a change in the age incidence and clinical type of PCM. However, the available information on this aspect is not clear and there is an urgent need to obtain more data from different countries. Similarly, further accurate information is required on the diets of preschool children, to understand the variations in clinical picture of PCM which is believed to reflect the complex interrelationship of the many causal factors.

The significance of foetal environmental factors including the maternal diet and nutritional status on the physical and mental development of the infant and child is discussed to highlight the importance of good diet for the potential mother even before she is born. The adolescent girl - mother - foetus - infant - child should be treated as a single unit for nutritional action. In the course of a discussion on the value of breast feeding for infants and the need to supplement breast milk with protein-rich, calorie-packed foods around the 4-6 month, the report states "that in spite of some scientific evidence that there are non-milk based foods which can be a substitute for milk for very young infants, the general consensus is that milk is still the best basis of food for infants aged 6 months or less".

The report underlines once again the close interrelationship between infection and nutrition and concludes that programmes to improve nutrition and reduce infectious disease are complementary and should proceed simultaneously in populations with PCM.

The present views on treatment of PCM are presented and the useful role of nutritional rehabilitation services is stressed. The current knowledge on the long term consequences of PCM with special reference to the possible effect on physical stature and intellectual performance is reviewed and it is stated that though data from longitudinal studies, already in progress, may help to assess the differential effect of nutritional and nonnutritional factors on these sequelae, the available information indicates that survivors of severe malnutrition in the first year of life are at a high risk of showing low levels of measured intelligence and lower competence in learning basic academic skills.

The report concludes its discussion on PCM by spelling out in detail the strategy of prevention to be undertaken in three phases and with five clearcut public health objectives. During the first phase efforts are directed towards treatment of PCM accompanied by nutritional rehabilitation. The second phase aims at achieving a better balance between treatment - rehabilitation on the one hand and specific protection and health promotion on the other. The purpose of the third phase is promotion of improved nutritional status and food habits in the community. In each one of the three phases, there should be a strong element of education of the family and the community with respect to nutrition, hygiene, child care,etc., including particularly education in lower cost nutritious foods that can be prepared at home and where appropriate, selective food buying.

The public health objectives are
(a) improvement and maintenance of good nutritional status
(b) control of infectious and diarrhoeal diseases
(c) minimizing the effects of infectious diseases
(d) early detection and management of mild cases of malnutrition
(e) improved treatment, early and complete rehabilitation of moderate and severe cases of malnutrition.

Singapore

SINGAPORE WORKSHOP

A workshop on what is needed to accelerate the marketing of optimum nutrition low-cost foods by the private food industry of Southeast Asia was held in Singapore on November 1-5, 1971. It was conducted by the League for International Food Education for the Office of Nutrition, US/AID, and was attended by food industry leaders from eight countries (Hong Kong, India, Korea, Malaysia, Philippines, Singapore, Thailand and Vietnam).

The food industry leaders stated their willingness to produce and market low-cost foods and their conviction of a social responsibility to do so. However, there were some constraints that needed to be overcome before they could go ahead:

1. A sound nutritional understanding and motivation - otherwise it is impossible to create a consumer market for such foods. Governments must play a major role in this either by using mass media such as radio or television or by purchasing complete nutrition

foods for institutional use.

2. Lack of sufficient information on available supplies and nutrient composition of food ingredients within developing countries. There was an urgent need for surveys to uncover suitable sources of such food ingredient data.

3. Lack of capital, which must be provided on a long-term basis at reasonable interest rates. It usually takes 7-8 years before marketing a high-nutrition, low-cost food becomes profitable. The customary interest rates for capital loans would be an impossible burden.

4. Lack of low-cost packaging materials. This might be solved either by large-scale production of a variety of packages in a regional center and supplying these to a group of developing countries, or by concentrating on a single type of package (such as glass) produced in each country.

5. Lack of coordination between research and development institutions. Much could be achieved by establishing organizations in each country which provide a common platform for discussion and formulation of policy between the different types of organizations.

A proposal was formulated for presentation to the World Bank as to what would be rational loan terms for enterprises aimed at providing low-cost, high-nutrition foods in developing countries.

An incentive grant plan was presented by the Office of Nutrition, US/AID. It would permit food industry businesses in developing countries to receive grants up to a limit of $30,000 each for consumer marketing studies and for such related purposes as would help accelerate the movement of high-nutrition, low-cost foods.

Guatemala City, Guatemala

SEGUNDA REUNIÓN CENTROAMERICANA SOBRE TECNOLOGÍA DE ACEITES, GRASAS Y PROTEÍNAS

El 28 y 29 de octubre de 1971, se realizó en el Instituto Centroamericano de Investigación y Tecnología Industrial (ICAITI), la Segunda Reunión Centroamericana sobre Tecnología de Aceites, Grasas y Proteinas, con la participación de 51 técnicos y personeros de las diversas fábricas de aceites y grasas de la región, representantes de las Cámaras de Industria y Gremiales Agrícolas, y expertos de agencias regionales e internacionales. En dicha reunión se trataron los siguientes temas:

- Procesamiento de proteína de semilla de algodón
- Utilización de la proteína de semillas oleaginosas
- Producción de proteína microbiana
- Aspectos nutricionales de las semillas oleaginosas
- Cuantificación de ácidos ciclopropénicos en semilla de algodón provenientes de ciertas zonas de Nicaragua, El Salvador y Guatemala
- Procesamiento de semillas oleaginosas y sus productos
- Aspectos analíticos sobre grasas y aceites
- Fuentes potenciales de lípidos en Centroamérica

La reunión revistió especial importancia en vista de la magnitud y el interés de la industria de grasas y aceites de la región centroamericana.

GENERAL ASSEMBLY RESOLUTION ON PROTEIN RESOURCES (2848(XXVI))

The United Nations Economic and Social Council at its meeting in August 1971 considered the report of the Secretary-General's Expert Panel on Protein Strategy and recommended *inter alia* that greater emphasis on this problem should occur in national development planning, that governments of developed countries should intensify their support for corrective programs by means of bilateral and multilateral action and that the protein problem should receive the attention of government planners at the highest level. With specific reference to the role of PAG, the ECOSOC resolution calls for participation in PAG by appropriate United Nations organs and Agencies, attendance of PAG experts at discussions of the protein question at meetings of Agency governing bodies and the presentation annually by PAG of a report to the United Nations on problems encountered and progress achieved in the solution of the protein gap. (The ECOSOC resolution was presented in full in Vol. II, No. 1 of the PAG Bulletin). During the 26th session, the United Nations General Assembly discussed the subject of protein resources and the ECOSOC resolution on the subject. The following is the text of the resolution adopted by the General Assembly.

The General Assembly,

Recalling its resolutions 2416 (XXIII) of 17 December 1968 and 2684 (XXV) of 11 December 1970, Economic and Social Council resolution 1640 (LI) of 30 July 1971, resolution WHA 22.56 of the World Health Assembly, adopted in July 1969, and resolutions 2/69 of November 1969 and 7/71 of November 1971 adopted by the Conference of the Food and Agriculture Organization of the United Nations,

Recalling also paragraphs 18 and 69 of the International Development Strategy for the Second United Nations Development Decade,[1)]

Bearing in mind the Declaration on the world food problem adopted on 22 March 1968 by the United Nations Conference on Trade and Development at its second session[2)],

Recognizing that the problem of protein is part of the general problem of food production and supply, which depends on a great many economic, social, cultural and political factors, including such factors as social and economic under-development, which is manifested in unemployment and under-employment, extremely low incomes, poor nutritional habits, poor health and sanitary conditions, low agricultural productivity and serious defects in marketing,

Recognizing also that protein-calorie malnutrition is the primary cause of high infant and child mortality, reaching from 25 to 30 per cent in many developing countries, and that it increases susceptibility to infection and can permanently impair growth and development in the survivors, to the detriment of their later physical and intellectual performance,

Considering that it is in the interests of developing countries to make increased use of the external - and particularly multilateral - financial and technical assistance available for dealing with problems of food supply and nutrition, since the direct and indirect costs of malnutrition to national development are often far more than the amount that would be required for its prevention,

Recognizing that, since the ultimate solution of the protein problem can only be found over the long term while immediate action with respect to vulnerable groups is required if irreversible damage is to be prevented, clear national and international priorities must be set now in taking remedial action, and that consequently external short-

[1)] General Assembly resolution 2626 (XXV).

[2)] *Proceedings of the United Nations Conference on Trade and Development, Second Session*, vol. I and Corr. 1 and 3 and Add. 1 and 2, *Report and Annexes* (United Nations publication, Sales No.: E.68.II.D.14), annex I, section A.1, resolution 9(II).

term assistance such as emergency food support must be combined with assistance for vital long-range projects,

Acknowledging the programme and assistance activities relating to the protein problem being undertaken by various organizations of the United Nations family, and particularly by the Protein Advisory Group of the United Nations system and its four sponsoring organizations - the United Nations Children's Fund, the Food and Agriculture Organization of the United Nations, the World Health Organization and the International Bank for Reconstruction and Development - and emphasizing that their efforts must be further integrated to achieve the maximum effectiveness,

Concerned that increasing awareness of the extent and implications of the problem of protein-calorie malnutrition has not led to the type and scope of national or international response required for an effective approach to the solution,

1. Urges developing countries to establish or emphasize short-term priorities and undertake special action and information programmes with regard to protein malnutrition in accordance with their respective national plans, since the alleviation of the situation in the short term must be based upon the improved utilization of existing national and international resources;

2. Urges the developed countries to reinforce their support for both bilateral and multilateral projects and programmes dealing with the protein problem in a manner compatible with the requests of the developing countries;

3. Urges developing countries:
(a) To draw up comprehensive statements of national nutrition policy and related food and agricultural policy to be incorporated, under the most appropriate administrative arrangements, in their development plans;
(b) To encourage and make the maximum use of surveys and studies of their food and nutrition situations and to encourage the training of the necessary professional personnel in science and technology related to food, agriculture, nutrition and other relevant fields;

4. Urges Governments to implement as appropriate, but as soon as possible, the essential elements of the Strategy Statement on Action to Avert the Protein Crisis in the Developing Countries, formulated by the Panel of Experts convened by the Secretary-General,[3] and as contained in the annex to the present resolution;

5. Requests appropriate United Nations organs, particularly the United Nations Development Programme, the specialized agencies and the International Atomic Energy Agency, to assist the developing countries, at their request, in all possible ways to implement the undertakings set out in paragraphs 1, 3 and 4 above;

6. Recommends to the sponsoring agencies that the terms of reference of the Protein Advisory Group should be modified as follows so as to enable the Group to broaden its activities and to play a more active and stimulative role:
(a) To advise on the technical, economic, educational, social and other related aspects of all the programmes within the United Nations system related to improving protein nutrition;
(b) To advise on current programmes and on new areas of activity:
(c) To provide guidelines for the formulation of the broad programmes of the United Nations system of organizations involved in the various aspects of the protein problem;
(d) To seek, evaluate and disseminate new information on all aspects of the protein problem;
(e) To advise on the improvement of procedures for project evaluation and feasibility studies;
(f) To identify, evaluate and advise on problems in protein resource development and protein-calorie malnutrition requiring scientific and technological research;
(g) To advise on such other matters as the various United Nations bodies refer to it;

7. Urges the United Nations bodies concerned, and in particular the World Food Programme, the International Labour Organisation, the United Nations Educational,

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[3] See Strategy Statement on Action to Avert the Protein Crisis in the Developing Countries (United Nations publication, Sales No.:E.71. II.A.17).

Scientific and Cultural Organization, and the International Atomic Energy Agency, to become full sponsors of the Protein Advisory Group so that it can effectively carry out its terms of reference in support of the United Nations system;

8. Requests, to this same end, the Secretary-General, in consultation with the Administrator of the United Nations Development Programme, the Secretary-General of the United Nations Conference on Trade and Development and the Executive Director of the United Nations Industrial Development Organization, to study and report to the Economic and Social Council at its fifty-second session on the possible modalities of United Nations sponsorship of the Protein Advisory Group;

9. Commends paragraphs 6 and 7 of Economic and Social Council resolution 1640 (LI) relating to further discussion of the protein strategy in other forums and the submission of annual reports by the Protein Advisory Group;

10. Welcomes the recent establishment by the Council of the Food and Agriculture Organization of the United Nations, pursuant to resolution 7/71 adopted by that organization at its sixteenth Conference, of a special seven-member committee to review the work of the organization in the protein field;

11. Requests the Economic and Social Council, during its discussion of the terms of reference of its Committee on Science and Technology, to give sympathetic consideration to inviting appropriate Protein Advisory Group representation to sessions of the Committee held to review and focus attention on the protein problem and to urging Governments, the United Nations and the specialized agencies concerned to assign representatives at a high level to attend such meetings;

12. Requests the Secretary-General, in co-operation with the Administrator of the United Nations Development Programme and in consultation with the executive heads of the organizations sponsoring the Protein Advisory Group, to arrange, at the request of Governments, for persons who took part in the panel convened by the Secretary-General in pursuance of resolution 2684 (XXV) of 11 December 1970 to visit Governments in order to enhance the establishment of national policies and arrangements to deal with the protein problem, and to report as appropriate to the Committee on Science and Technology;

13. Further requests the Secretary-General to seek the views of Governments on the recommendation of his panel and of the Advisory Committee on the Application of Science and Technology to Development for the establishment of a special protein fund under the United Nations Development Programme in order to ascertain the views of Governments on its feasibility and to ascertain whether significant resources would be made available to it without prejudice to the increased resources envisaged for the Programme, and to report to the General Assembly at its twenty-seventh session through the Economic and Social Council.

CONSULTATIVE GROUP ON INTERNATIONAL AGRICULTURAL RESEARCH URGES $15 MILLION FOR RESEARCH PROGRAMMES IN 1972

The following is reproduced as received from the International Bank for Reconstruction and Development, Washington, D. C.

A newly founded international group of governments and organizations has indicated an intention to make approximately $15 million available in 1972 for research programmes designed to raise the quantity and quality of food production in the developing countries of Asia, Africa and Latin America, it was announced on 6 December.

The financing for next year was indicated in statements by members of the new International Consultative Group on International Agricultural Research at a meeting of the Group at World Bank headquarters in Washington, D. C., on Friday and Saturday. The funds will support five widely separated international research centres already in existence. In addition, steps have been agreed upon looking to the establishment of two major new programmes in India and Africa.

Two of the existing institutions being supported are responsible for the developments that led to the "green revolution" in the form of greatly increased food production, especially in Asia and Latin America, from new varieties of wheat and rice. One of these institutes is the Wheat and Maize Improvement Centre, situated in Mexico, and the other is the International Rice Research Institute in the Philippines.

The other existing programmes which will be supported by grants from individual members of the Consultative Group are those of more recently established centres - the International Potato Institute, in Peru, the International Centre for Tropical Agriculture, situated in Colombia, which is concerned with farming systems suitable to the humid tropics of South America, with particular attention to the improvement of beef, corn and cassava, and the International Institute for Tropical Agriculture, in Nigeria, which is concerned with farming systems appropriate to the humid tropics of Africa and is now concentrating on corn, rice, certain legumes and root crops.

The Group action announced on 6 December will also provide initial funds for an international centre for crops research for the semi-arid tropics. The centre, proposed to be located in India, would concentrate initially on the improvement of sorghum, millet, chick peas and pigeon peas. In addition, studies will be undertaken for the Group which look toward research designed to spread the green revolution further by developing new varieties of beans and other legumes with greater yields and higher protein content than today's varieties.

The Consultative Group has 27 members. Three are private organizations - the Ford, Rockefeller and Kellogg Foundations - which have pioneered (and are continuing) in the support of agricultural research. Three are bodies in the United Nations system - the Food and Agriculture Organization (FAO), the United Nations Development Programme (UNDP), and the World Bank - which joined together in sponsoring the Group.

Twelve donor governments are members. They include those of Belgium, Canada, Denmark, France, the Federal Republic of Germany, Japan, the Netherlands, Norway, Sweden, Switzerland, the United Kingdom and the United States. Three regional banks - the African Development Bank, the Asian Development Bank and the Inter-American Development Bank - belong, as does the International Development Research Centre, an autonomous organization financed by the Government of Canada.

In addition, the five major developing regions of the world participate in the Consultative Group through representatives designated for a two-year term by the membership of FAO. Each region has designated two countries which serve as member or alternate at their discretion. The countries designated are: for Africa, Morocco and Nigeria; for Asia and the Far East, the Philippines and Thailand; for Latin America, Argentina and Brazil; for the Middle East, ~~Lebanon~~ and Pakistan; and for Southern and Eastern Europe, Israel and Romania. Representatives of Brazil, Israel, Lebanon and Morocco participated in the meeting of the Consultative Group just concluded.

The actions taken by the Group were based on consideration of the recommendations of the Group's Technical Advisory Committee, an international group of 12 distinguished experts under the chairmanship of Sir John Crawford, Vice-Chancellor of the Australian National University. The Group, which held its first meeting in the spring of 1971, intends to meet again in Washington in the autumn of 1972.

NOVEL PROTEINS*

A. Protein from cheese whey

A new process for producing protein has been developed using whey, which is produced in large quantities by cheese factories. Whey contains high percentages of milk sugar (lactose) and is generally used as cattle fodder or is discharged directly to the central sewage system.

Special yeasts, Saccharomyces fragilis or Candida utilis, have now been found to utilize lactose for the production of comparatively high-value protein. The process is based on the splitting of lactose to glucose and galactose by an enzyme which is produced by the inoculated microorganisms.

Saccharomyces fragilis is capable of assimilating both products, i. e. glucose and galactose; Candida utilis, however, cannot use galactose and the protein produced must be separated from the galactose by means of dialysis or crystallization. The production of yeast from whey is interesting since whey is a very cheap raw material and because processing in modern factories is a completely hygienic operation such proteins can be used not only for cattle fodder but also as additives to food for human consumption.

B. Protein from soluble and insoluble starches

Starch-producing industries often have considerable wastes of soluble and insoluble starches. These wastes, having a high dry solids content, place an enormous load on the central sewage system. Now a new process producing high percentage protein has been developed utilizing this waste water and two separate microorganisms, Endomycopsis fibuliger and a yeast. The former dissociates the starch to glucose and the latter uses the glucose for metabolism to protein. Following this conversion the product is separated and can be spray-dried or freeze-dried depending on the demands of the consumer.

These two new processes show that it is possible to eliminate a water-polluting product by converting it to a more useful and profit-making product.

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* From material supplied by Chemapec, Inc., Hoboken, N. J., U. S. A.

SOYBEAN PRODUCTION AND MARKETING IN INDIA

Soybean Marketing Information[*] is a newsletter with the purpose of improving market knowledge of the soybean.

The newsletter gives information on production and supply of soybeans, plans for and developments in soybean processing and utilization, and available and potential markets for soybeans and soybean products. It is the aim of the editors to be helpful in guiding the development of the soybean industry.

The newsletter states that the production target during the remaining three years of the fourth plan of the Government of India has been proposed as follows:

	Area (hectares)	Production (metric tons)
1971-72	45,000	56,000
1972-73	180,000	225,000
1973-74	400,000	500,000

The Food Corporation of India has decided to set up a 100-ton capacity soybean processing plant with a large-size extraction unit of 250 tons per day capacity with the assistance of UNICEF.

NUTRIBUN

Nutribun, a wheat food developed by Wheat Associates, U.S.A., is being marketed commercially in the Philippines in cooperation with the Greater Manila Baker's Association. According to the Association Secretary, commercial success of the product in the Philippines has been "immediate and spectacular". Formulated for the Bureau of Public Schools' Feeding Program in the Philippines, Nutribun became a major emergency relief food item.

WHEAT SUBSTITUTES USED IN DEVELOPING NEW BREAD[**]

Research has been done on making acceptable bread using wheat flour which is partly substituted by other tropical starch materials and cassava to give a satisfactory protein content. Sources of protein other than soy flour were used to enrich the bread.

The experiments used sorghum, rice, maize, millet, yams, breadfruit and bananas to dilute the wheat flour. Cottonseed flour, groundnut flour, fish protein concentrate, defatted soy flour and coconut protein were added as a protein supplement.

Loaves made with fish protein did not rise, were grey in color and had a strong fishy taste. The most successful protein supplements were soy and coconut protein. Sorghum, rice and maize as substitutes for the wheat give acceptable loaves. Most research, however, was carried out on cassava and it was found that substitution up to 40-50%, depending on the process used, still produces a satisfactory loaf provided a strong wheat flour is used. The results were confirmed in a commercial bakery and although the bread was not quite as good as that produced in the test bakery, it was thought that with only minor modifications the same results could be obtained.

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[*] Dept of Agricultural Economics and Farm Management, J. Nehru Krishi Vishwa Vidyalaya, Jabalpur, MP, India

[**] From an article by Dr. D. Dendy, in The Miller, March, 1972.

It now seems possible that in many tropical areas bread containing a proportion of local materials can be made so that foreign exchange will be saved and a stimulus can be given to local products.

N. S. Scrimshaw and A. M. Altschul, eds.:

AMINO ACID FORTIFICATION

This book represents the report of the International Conference on Amino Acid Fortification of Protein Foods, which was held at the Massachusetts Institute of Technology in September 1969. The conference was organized by the Joint Malnutrition Panel of the U.S. - Japan Cooperative Medical Science Program and the MIT Department of Nutrition and Food Science. The book includes the contributions made by leading medical nutritionists, agricultural specialists, food scientists and technologists, economists and planners from several countries who attended the meeting.

It begins with a discussion of the protein problem and its complex relationship to agricultural and general economic development. Eradication of protein malnutrition in children and an increase in the daily protein intake of the members of a community cannot be achieved automatically through general economic development alone. Similarly, the explosive increases in food production (Green Revolution) now taking place in many areas of the world may not represent the whole answer to these problems unless appropriate nutrition strategy is built into each one of these developmental efforts. The next section describes some of the several strategies available for improving the quality and increasing the quantity of protein intake such as increased production of legumes, breeding varieties with higher protein value and better amino acid pattern, supplementation of staple foods with proteins derived from oilseeds and other new protein sources and development of low-cost protein foods using modern technology. It is obvious that none of these strategies is mutually exclusive and their selection and priority depend on several local factors.

Section III provides a documentation of the available world literature on the value in experimental animals and in humans of the addition of amino acids which are limiting in diets of relatively poor protein quality. The results of the several studies reviewed suggest that under experimental conditions appropriate amino acid supplementation of the protein-deficient diet could improve the nutritive value of the dietary protein. In most of the studies, single protein sources or simplified diets have been used and the diet was adequate with respect to calories and the other nutrients. In a real-life situation, it is necessary to determine the limiting amino acid(s) in the mixed diets consumed by the population and the diets' adequacy with regard to calories and other nutrients before the value of amino acid fortification is tested in the community. Evaluation of the effectiveness of an amino acid fortification program calls for techniques which are largely the same as those in use for evaluating the effects of various nutritional intervention programs.

Section IV provides details of planning and design of field studies, the selection and use of different types of indicators and the interpretation of results.

Section V describes amino acid production by fermentation and chemical synthesis. The available evidence suggests that amino acid fortification of many foods is technologically feasible without impairing the organoleptic properties and does not interfere with food acceptability among the population. However, many problems exist in the application of this technology to fortification and in the handling and distribution of fortified food in developing countries. These and the problem of economics of fortification strategy are aspects of work which require further study and research. It would appear that a final decision to adopt fortification as a strategy should be taken at the national level as part of the national food and nutrition policy.

The final section, consisting of five articles and a panel discussion, is an analysis of amino acid fortification as a strategy for meeting protein needs and a comparison of its merits in relation to other approaches. The emphasis is clearly that the choice of approach is influenced by a multiplicity of factors which may change from time to time and differ from place to place in the same country. This would make the strategy selected now inappropriate after a period of time or in a different part of the same country.

The book includes speeches made at the Anson Memorial Dinner and also the PAG statement on amino acid fortification of food (Statement No. 9).

Scrimshaw, Nevin S. and Aaron M. Altschul. (eds.). 1971. Amino acid fortification of protein foods. The MIT Press, Cambridge, Mass., U.S.A. 664 pp. $25.00.

RECENT PUBLICATIONS

De, S. S., and J. A. Cornelius. 1971. Technology of production of edible flours and protein products from groundnuts. FAO, Agricultural Services Bulletin No. 10. Rome, Italy.

FAO/WHO. 1971. Toxicological evaluation of some extraction solvents and certain other substances. Expert Committee on Food Additives. FAO Report Series No. 48A; WHO/Food Add./70.40.

Institute of Food Technologists. 1971. Proceedings of the Third International Congress of Food Science and Technology (SOS/70) held in Washington, D.C., August, 1970. IFT, Chicago, Ill., U.S.A. 951 pp. $15.00.

Tropical Products Institute. 1970. Proceedings of a symposium on the use of non-wheat flour in bread and baked goods manufacture. Report No. G62. TPI, London, England.

PAG STATEMENTS AVAILABLE

No.	Title	Date
2	PAG Recommendation on aflatoxin	1969
✓3	PAG Statement on the nature and magnitude of the protein problem	1971
4	PAG Statement on single cell protein	1970
✓5	PAG Statement on the marketing and distribution of protein-rich foods	1971
6	PAG Statement on milk substitutes	1970
7	PAG Recommendation on prevention of food losses and protein-calorie malnutrition	1969
8	PAG Statement on plant improvement by genetic means	1970
9	PAG Recommendation on amino acid fortification of foods	1970
✓10	PAG Statement on a systems approach to the formulation and evaluation of nutrition intervention programmes	1970
11	PAG Statement on leaf protein concentrate	1970
✓12	PAG Statement on the world protein problem: research and development needs	1971
13a	Review of the specific proposals contained in ACAST report "International Action to Avert the Impending Protein Crisis" United Nations, 1968	1971
✓14	PAG Statement on marketing of conventional foods	1971
✓15	PAG Statement on popular participation and community involvement in nutrition improvement programmes	1971
✓16	PAG Statement on the potential of fish protein concentrate for developing countries	1971
17	PAG Statement on low lactase activity and milk intake	
18	PAG Statement on relationship of pre-and post-natal malnutrition in children to mental development, learning and behavior	
19	PAG Statement on maintenance and improvement of nutritional quality of protein foods	
21	PAG Statement on specifications for solvents	

PAG GUIDELINES AVAILABLE

No.	Title	Date
2	PAG Guideline for preparing food-quality groundnut flour	1970
4	PAG Guideline for preparation of edible cottonseed protein concentrate	1970
5	PAG Guideline for edible, heat-processed soy grits and flour	1969
6	PAG Guideline for preclinical testing of novel sources of protein	1970
7	PAG Guideline for human testing of supplementary food mixtures	1970
8	PAG Guideline on protein-rich mixtures for use as weaning foods	1971
✓9	PAG Guideline on fish protein concentrate	1971
✓10	PAG Guideline on marketing of protein-rich foods in developing countries	1971
11	PAG Guideline for the safe production and use of dried protein foods	
12	PAG Guideline on the production of single cell protein for human consumption	
14	PAG Guideline on the preparation of defatted edible sesame flour	

PAG Statements and Guidelines may be used and quoted freely. Copies may be obtained without charge from the Protein Advisory Group of the United Nations System, N.Y. 10017, U.S.A.

MEETINGS

June 8 - 10, 1972	INTERNATIONAL CONFERENCE ON FPC. Contact: Dr. S. R. Stillings, Dept. of Nutrition and Food Science, MIT, Cambridge, Mass. 02139	CAMBRIDGE, MASSACHUSETTS
June 8 to 10, 1972	SEVENTH INTERNATIONAL WORKING AND DISCUSSION MEETINGS OF THE INTERNATIONAL ASSOCIATION FOR CEREAL CHEMISTRY. Contact: The Association, A-2320 Schwechat, Schmidgasse 3-7, Austria	VIENNA, AUSTRIA
August 21 and 22, 1972	INTERNATIONAL SYMPOSIUM ON CONTROL OF MYCOTOXINS. Contact: Swedish Institute for Food Preservation Research, Fack, S-400 21 Goteborg 16, Sweden	KUNGALV (near GOTEBORG), SWEDEN
September 3 to 9, 1972	NINTH INTERNATIONAL CONGRESS OF NUTRITION. Contact: Dr. Adolfo Chávez, Viaducto Tlalpan y San Fernando, México 22, D. F.	MEXICO CITY, MEXICO

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PAG BULLETIN

Protein Advisory Group of the United Nations System
United Nations, N.Y. 10017
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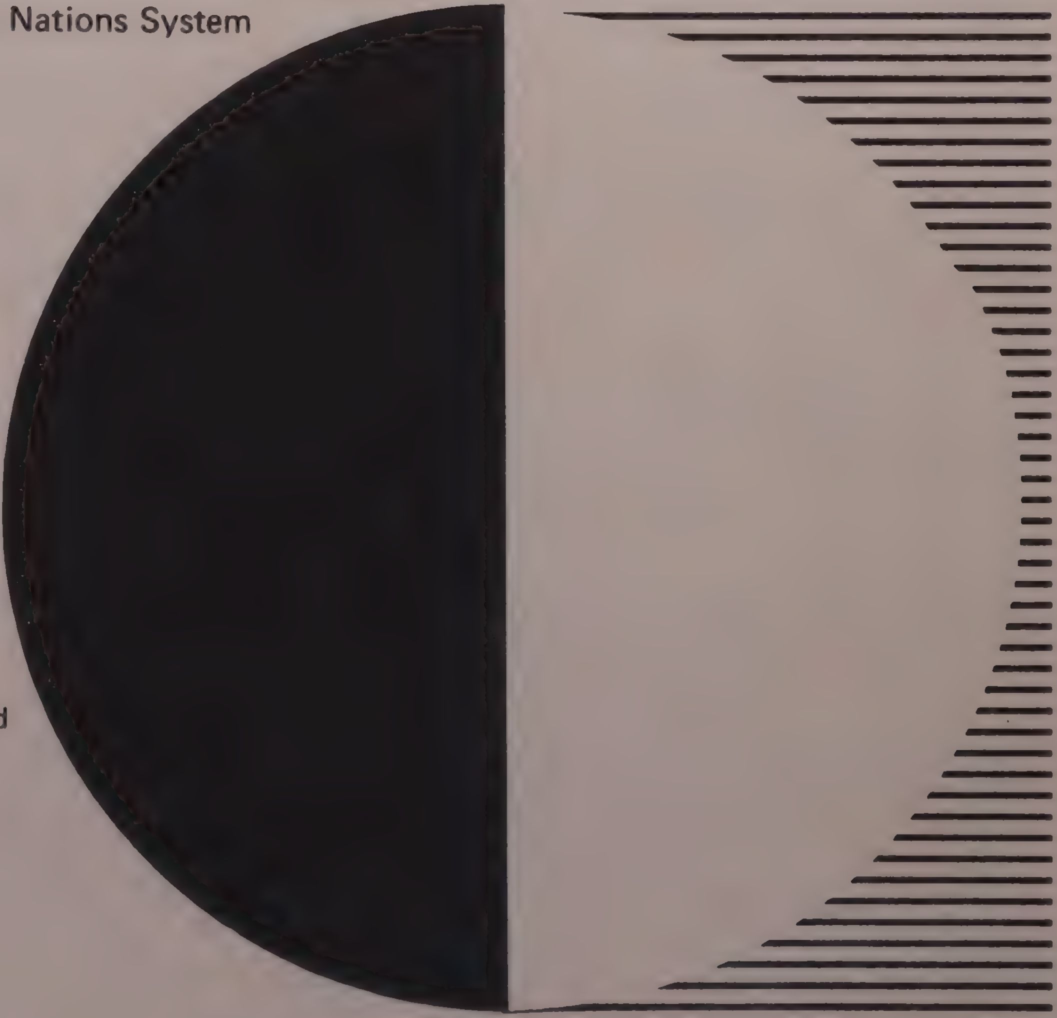

Food and Agriculture
Organization
of the United Nations
Rome

World Health Organization
Geneva

United Nations Childrens Fund
New York

International Bank
for Reconstruction and
Development
Washington

International review of action to improve world protein nutrition

THE PAG BULLETIN

PURPOSE

The *PAG Bulletin* is published by the Protein Advisory Group of the United Nations System. Its purpose is to give information on the world protein problem to those individuals, academic institutions and industrial organizations which are interested in helping solve the protein problem and to promote the exchange of information in this field.

MAILING LIST

The *PAG Bulletin* is sent without charge to persons, organizations, and companies with an active interest in proteins. The present mailing list comprises about 3500 names, approximately fifty per cent in the U. S. A. and the rest distributed throughout the world. Requests to be added to the mailing list for the *PAG Bulletin* should be addressed to the Director of Secretariat, Protein Advisory Group of the United Nations System, United Nations, N. Y. 10017, U. S. A.

QUOTATION

Permission to quote items from the *PAG Bulletin* is not required except from authors of signed articles. The Secretariat of the PAG would appreciate being informed of quotations made from the *PAG Bulletin.*

SUGGESTIONS

The *PAG Bulletin* will be successful only if it reflects all aspects of the protein problem comprehensively and objectively. The Secretariat invites suggestions and ideas for broadening and deepening the scope of the *PAG Bulletin.*

SECRETARIAT

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NOTE BY THE SCIENTIFIC SECRETARY

An area of unfinished business of the Green Revolution is the need to upgrade the nutritional quality and productivity of food legumes, in order to improve their dietary impact and increase their agroeconomic competitiveness with wheat, rice and maize. The urgency for attention to these traditional food crops is highlighted by the recent decreasing trend in their availability, at least in India where they are the major protein supplement for cereal diets and where they play a significant role in desirable cropping practices.

The PAG has frequently emphasized the need for improved varieties of food crops, particularly the legumes, in order to provide more protein of better nutritional quality in developing countries. Strong endorsement of these recommendations (PAG Statement No. 8) appeared recently in the United Nations Secretary-General's Strategy Statement on Action to Avert the Protein Crisis (reviewed in PAG Bulletin 12). More recently at its 19th Meeting, the Group considered a comprehensive statement "Need for Nutritional and Food Quality Guidelines for Plant Breeders" (which appears in this issue of the Bulletin) and it recommended appointment of an ad hoc working group to develop such guidelines.

In carrying out this mandate, the Secretariat, with the cooperation and sponsorship of several international bilateral agencies and an interested foundation, convened at FAO in Rome early in July 1972 a PAG Symposium on Nutritional Improvement of Food Legumes by Breeding. An invited group of plant breeders, biochemists, nutritionists and food technologists developed recommendations for achieving the following objectives in legume improvement:

1. Higher protein levels and better amino acid profiles
2. Reduction of toxic constituents
3. Elimination of flatulence factors
4. Development of improved processing and consumer acceptance properties
5. Compilation of useful screening methodology for measuring chemical, biochemical, nutritional and toxicological factors
6. Expansion of needed research efforts in these areas as well as those related to crop yield and productivity.

The program of the meeting will be described in the next issue of the Bulletin. The papers and discussions as well as recommendations of the participants will also be published.

Following this Symposium, a PAG ad hoc working group met and drafted a PAG Statement "Upgrading Human Nutrition Through Improvement of Food Legumes", which will be considered for approval by the PAG Steering Committee in December 1972. It will then be available for wide dissemination.

STATEMENT BY DR. NEVIN S. SCRIMSHAW, CHAIRMAN OF THE PROTEIN ADVISORY GROUP OF THE UNITED NATIONS SYSTEM TO THE UNICEF EXECUTIVE BOARD, 26 APRIL 1972

It is a great privilage to meet with this group and I will try to speak concisely and clearly. In doing so I may seem dogmatic on some issues and I'll be very glad to respond later to questions. The first issue to which the Chairman of the Protein Advisory Group should perhaps address himself is whether there is a protein problem in the world and why; or is there simply a food problem or a protein-calorie problem? I think it's generally understood that *per capita* calorie information gives a reasonably reliable indication of the caloric adequacy for populations because people can only eat a few more calories than they require without becoming obese to a point beyond which this could not continue. If calories are inadequate people adapt by reducing their physical activity, and will reduce physical activity as long as this is possible. And this is the only way, of course, that large populations of the world survive on caloric intakes which are so obviously below those recommended. But when we come to protein, the situation is quite different because people can and do consume much more protein than they really need; two or three times as much in some cases, if they can afford it and the food is available. And, therefore, *per capita* availability of protein becomes a very poor indicat of the protein problem or protein malnutrition within any country. Protein supplies must exceed estimated protein requirements by a considerable factor or there will be serious protein malnutrition in a country. Just how much protein supplies must exceed protein physiological needs depends, of course, on the economic status, dietary patterns and other considerations within a country. It is not only that the low income groups, in general, receive the lesser part of the available protein supply, but within the low income groups, there are the so-called vulnerable individuals, particularly the young children and the nursing and pregnant mothers. So there is a protein problem because of the inevitability of maldistribution of protein.

There is also more of a protein problem than is recognized from general statistics or the kind of tabulations that a statistician in FAO might make, for example, because the requirements or the recommended allowances have been developed for children who are generally healthy in an essentially sanitary and privileged environment. But the children of developing countries are heavily exposed to frequent diarrheal and other infections and these infections not only result in a decreased protein intake through a withdrawal of much of the solid food in the diet and, if the intestinal tract is affected, a decrease in the absorption of protein, but there is also a direct increased metabolic loss of protein. This comes about because amino acids are mobilized from skeletal muscle through the stress mechanism and are used for synthesis of glucose in the liver with a loss of the nitrogen portion of the molecule. This means that after each infectious episode, the amount of protein required is not that for a healthy well-nourished child but is now increased by an extra amount of protein to replace that which has been lost. A third reason why we have a protein problem is that the basic staples of the populations of developing countries are either cereals or roots and tubers. The cereals do not have a high enough protein value to satisfy the needs of the vulnerable groups, particularly under the conditions of a heavy burden of infection,and the roots and tubers have an even lower protein value. These high carbohydrate foods need to be supplemented either by legumes or by animal protein, and both are relatively costly in a developing society and frequently not sufficiently available.

In the case of animal protein, it's clear that an increase in animal protein production within a country can, under some circumstances result in an exacerbation of the protein problem. We see this in Central America today where ther is increased beef production. It is being sold to the United States and to some extent to Europe. The price of meat has gone up considerably in Central America; the poor people of that region simply can't compete with the purchasing power of the industrialized countries.

In the case of the legumes which are the traditional supplements of a cereal diet, the Green Revolution has led to an increase in the production of high-yielding varieties of cereals. Since they are more profitable to grow, there has been a trend to a decrease in legume production or at least a decrease in legume production per capita. This was evident even before the Green Revolution but has been accelerated by it, with the result that legume availability has decreased, legume prices have risen and there has been an exacerbation of the protein problem in the presence of increased availability of food.

Because there is a world protein problem, the Protein Advisory Group, originally advisory to FAO, WHO and UNICEF, and now extended to be advisory to the entire United Nations system, tries to assemble experts from many different disciplines to look at the problem as an integrated whole, not from the viewpoint of the programs and terms of reference of a specific agency, but what the United Nations system as a whole can and should be doing about this problem. To the extent that specific problems are beyond the competence of any single multidisciplinary group, the United Nations can convene working groups to deal with specific problems to make the best knowledge and experience on a subject available to the agencies of the United Nations system. UNICEF, perhaps because it is concerned with overall programs for children, rather than specific disciplinary areas, has been particularly helpful and supportive of the broad analytical PAG approach to problems, and this is reflected in the excellent General Progress Report of the Executive Director which takes into account the discussions of the various working groups of the PAG and the analysis that the PAG has made of various aspects of the overall protein problem.

Having explained the reasons for an emphasis on protein, I would like immediately to emphasize that, of course, protein without adequate calories would be of little value and, of course, the PAG must look at the total nutritional problem, protein relative to calories and the other essential nutrients which are necessary for the utilization of protein. In fact there was consideration as to whether the name should be changed to the Protein-Calorie Advisory Group or even to the Nutrition Advisory Group, but it was concluded that protein was a major problem and deserved this kind of emphasis. With the Green Revolution, the world as a whole seems assured of the food necessary for the population increase in the decades immediately ahead, and the cereals contain the proportion of protein which is needed to sustain adult populations, at least those in a healthy state, but as I've indicated, the successes in cereal grain production, those marvelous and critically important food production successes of the Green Revolution, will in the short run, at least, exacerbate rather than solve the protein problem for some populations. As the PAG recommendations have indicated and as highlighted in the Strategy Statement on Action to Avert the Protein Crisis in Developing Countries of the United Nations Secretary-General's Panel of May 1971, there are a series of specific measures which will in time balance the effects of the Green Revolution to ensure overall availability of protein. These include the improvement of the nutritional value of cereal protein through genetic engineering (plant breeding), and the PAG is convening a working group on the nutritional goals of plant breeding to meet in Rome in July of this year. There must also be a very much higher priority for expanded research on developing high-yielding pulses, legumes and oilseed crops and there must be the utilization of these oilseed crops and other sources of protein for the development of low-cost, protein-rich foods for the feeding of vulnerable groups.

A second current trend which is a matter of concern, the first being some of the secondary effects of the Green Revolution, is the trend to urbanization and its effects on populations that abandon traditional food habits, particularly breast feeding. There needs to be an emphasis on continuing breast feeding and on better supplementation of breast milk in both urban and rural populations. Because to some extent the trend to abandonment of breast feeding in urban populations is probably irreversible, good substitutes for breast milk which are safe, nutritious and within reach of the lower income groups in the cities are also needed; and mothers must learn how to use these substitutes properly.

UNICEF is specifically concerned with children and with time has come to focus more sharply on the young child as urged over the years by the PAG. Why the young child? Perhaps it's unnecessary in this group to review why, but I would like to emphasize that it is because breast feeding, even in a privileged situation, is adequate to provide the sole source of food for the infant only until about six months of age. In a developing country where the mother is somewhat malnourished and therefore the quantity of her milk may be reduced, where the child has been born of a malnourished mother and therefore his nutrient reserves are low, and where the child even at this very early age experiences episodes of diarrhea and other infectious disease, breast feeding is often not adequate beyond three or four months of age; there must be a supplement of protein and other essential nutrients to breast milk if the child is going to develop normally.

The second reason why emphasis must be on the young child lies in the effects of infections to which I have already referred. The young child in the developing country is exposed to an unsanitary environment at the very time when breast milk is increasingly inadequate as a source of food and when supplementation is inadequate and, therefore, his resistance to infection is lowered. Because his resistance to infection is lowered, he develops episodes of disease which either would not occur or would be less severe in a well-nourished child even in such an unsanitary environment. The episodes of infection themselves further exacerbate the malnutrition. We have then among young children in developing countries a synergistic interaction of malnutrition and infection whereby the consequences of the two together are worse than could be predicted from either alone. Programs for the preschool child must be directed at both aspects of the problem, i. e. improving his nutritional status and reducing to the extent possible the burden of his exposure to infection through proper immunization programs and through better environmental and personal hygiene.
I emphasize personal hygiene because the construction of latrines, for example, is not going to reduce diarrhea in young children if the mother doesn't wash her hands after using them and her contaminated hands are used to put her nipple into the child's mouth or to wipe the curd out of the child's mouth or in other ways to contaminate him. So what we are saying is that nutrition programs must be an integral part of maternal and child health programs, which incorporate immunization and education towards improved personal hygiene and environmental sanitation.

Another reason why the young child is an important target group is that the consequences of malnutrition for the preschool child are not only a retardation in physical growth and development which is not made up but also an effect on the child's mental development and subsequent learning and behavior. Now here is a point on which I wish to speak very carefully because there has been much exaggeration and some misstatement to the point where the credibility of this kind of a statement comes into question. We have learned a lot more in the last two years as to the probable relationship between early malnutrition and subsequent poor performance in school and on tests of learning and behavior. Two or three years ago we would still have said that the animal studies which show that severe early malnutrition results in a reduction in the total number of cells in the brain, poor myelinization of nerves and other changes in the central nervous system, would be the mechanism for this effect, and that since these maturation processes are complete within the first 12 to 18 months after birth that malnutrition would have this effect only in these early months and through these morphological changes. It has been observed, however, that one of the effects of supplementary feeding is to increase the amount of mother-child interaction. A malnourished child is likely to stay apathetically on the mother's back or to sit where he is placed in the corner of a house, whereas a child when he begins to be properly fed is no longer so passive. He will be crawling around the house; he will be trying to get into the cooking pot or maybe getting his hands in the fire. He will be calling for attention, be crawling out the door and will force an interaction between mother or other persons and the child. It has long ago been shown from studies in experimental animals that either nutritional deprivation or sensory degradation will result in impaired development of the central nervous system and subsequent learning and behavior. Recently there have been studies which suggest that even children born at the severe disadvantage of very low birth weight will develop quite normally by the stimulus of a privileged environment. It is increasingly probable that the effects of early malnutrition on subsequent learning and behavior are mediated mainly through this indirect mechanism rather than through the direct mechanism, but this obviously doesn't make them any less important; if anything, it makes it even more important to correct early malnutrition before permanent damage has been done. But it also means that malnutrition at a slightly later period when the central nervous system is completely formed can also have an effect on subsequent performance by decreasing the amount of stimulus which the child receives.

Now what about "school aged" children? School children are easy to reach and they are an important segment of society. The reason why school children should not have the same priority as preschool children is simply that by the time a child reaches school age his competitive position in the family has improved, to some extent he can compete or forage for food for himself, his requirements per kilo of body weight are somewhat less and of special importance is the fact that he has now acquired resistance or relative resistance to many of the infections which complicate nutritional status at an earlier age. It is significant that when school children in developing countries are studied, it is found that their growth and development tends to parallel that of well-nourished children anywhere and that supplementary feeding generally does not produce a detectable improvement in their growth and development or clinical status.

The other group which we recommend as a priority group are pregnant and nursing mothers, and here I think the reason is quite clear; the child born of a malnourished mother is born with lower nutrient reserves. If at that point his diet were now made ideal, the damage would be corrected, but since this is rarely the case, the effects of malnutrition in pregnancy and in the first year of life are cumulative and that much more serious. Moreover, the data now available from many studies document the increased perinatal mortality associated with 200 to 300 grams lower birth weight of children of malnourished mothers and the benefits on decreasing perinatal mortality from improvement of maternal nutrition. The emphasis on nutrition during the lactation period has a dual purpose. One, of course, is the maintenance of adequate lactation, but more important is to avoid the debilitation of the mother which otherwise comes from cycles of pregnancy and lactation with the consequences for later children being that much more severe.

Given these priority problems, what should be done? Feeding programs for young children are obviously of great importance. But simple programs of distribution of supplementary foods for preschool children don't necessarily eliminate the development of severe protein-calorie malnutrition in this age group and there is a need for special efforts with respect to prevention. Education is an important element and I shall return to this later. Surveillance and, when necessary, facilities for treatment of severe malnutrition are also needed. The most dramatic example that I can give of this comes from the situation as it existed in the refugee camps among the Pakistani refugees only a few months ago. When I visited the camps last August, the families were receiving an adequate ration and from the standpoint of the food which was made available there would be no reason for serious malnutrition. What we found in some camps, was that one child in five had either the edema, the skin lesions, the hair changes, the full-blown syndrome of kwashiorkor or the characteristic loss of subcutaneous tissue and skin-and-bones appearance of infantile marasmus. We found that some camp commanders considered that the disposal of child bodies was their number one problem; in the monsoon season with no crematorium facilities they were desperate. We found that the frequency of this severe form of protein-calorie malnutrition among young children was not apparently different in camps where the Red Cross was distributing milk or CSM to all young children who were brought to get it. The reason was that under the almost complete lack of sanitation in the camps and the crowding together, the children had diarrheal disease and other infections a great percentage of the time, and that when they had these infections the families would not give them solid food. They would even barter food to get barley to give the children barley water. Thousands and thousands of children were receiving barley water and were developing severe protein-calorie malnutrition.

It was in this situation that lifeline BETA was conceived and even before my visit UNICEF had risen to this occasion and established the supply pipeline. It took time to overcome bureaucratic obstacles and financial problems but ultimately a rehabilitation-type program, called "lifeline BETA", went into the refugee tents and the shelters and found the children who were lying on the floor with edema or with marasmus and needed the food but were not being brought to any central point. When the program found these children and saw that they got proper feeding, the situation began to change and I know from firsthand accounts, when I was back in January, that many thousands of children were saved by the lifeline BETA program of UNICEF. Perhaps more important than the lives that were saved was the reduction in the number who underwent marasmus for so many weeks and months that their future development was permanently impaired.

Now what I have just described for the Pakistani refugee camps is simply a concentration of what goes on throughout India and Pakistan and all other developing countries all of the time, and it is an illustration of why you have to have more than a feeding program for people who come in to a central point. You have to have a maternal and child health program which will reach out into the homes - reach out to the mothers - and you have to have within that program provision for specific rehabilitation of those children who have become seriously deficient. It has become apparent that most protein-calorie malnutrition can actually be handled on an out-patient or even a domiciliary basis if proper food is made available along with instruction and encouragement as to how to use it. Hospitalization is costly and not usually necessary because what these children really need is not hospital care but proper feeding.

In "what should be done", education also figures prominently. After all it is the general feeding practices of the mother, the food habits of the population, the other health practices, personal hygiene and the like which need to be changed and which will reduce the need for rehabilitation programs and supplementary feeding. Here we are less satisfied with the methodology available, and there is serious examination of the effectiveness of past and present nutrition education programs and a search for better methods including possibly the extensive use of mass communications.

The benefits that would accrue from these programs to reduce malnutrition among the target groups are clear; reduction in morbidity from disease, an improvement in the growth and development of children, a removal of barriers to their reaching their full intellectual potential, a decrease in the present high infant and preschool child mortality, and finally, one which we have not mentioned as yet, and that is favorable repercussions on family planning. Family planning programs have undoubtedly been greatly impaired in their effectiveness by continued high mortality. In developing countries, families depend on surviving children to care for them in their old age and a family planning program is much more difficult to introduce where there is still a need for a large number of children to have sufficient surviving. I need hardly add that the total number of children for a country, i.e. the macro aspect of family planning, represents only one part of the picture. The other part is the micro aspect, the benefits to the health of individual children if they are better spaced and if the number are within the capacity of the family to care for.

Many PAG activities are conducted by ad hoc working groups. The ad hoc working group on "Feeding the Preschool Child" of the PAG has considered and prepared reports on such topics as nutrition in utero; nutrition requirements of infants and young children; family planning, fertility and nutrition; socio-cultural dynamics of breast feeding; formulations for infants under six months deprived of breast milk; home-prepared weaning foods; introduction of processed protein-rich foods; standards and regulations for infant and weaning foods; channels for influencing preschool child feeding; interactions of nutrition and infection in the preschool child; special mixtures for treatment of protein-calorie malnutrition and for use in supplementary feeding; preschool child feeding in times of disaster; and nutrition in pediatric medical training. At its next meeting later this year the working group will be considering several additional subjects and will be focusing particularly on legislation for protection of children and mothers.

The PAG traditionally has been concerned with the evaluation of new sources of protein and in the development of low-cost, protein-rich foods using these new sources and has particularly explored the oilseed meals and recommended oilseed meal-cereal mixtures. Ad hoc working groups of the PAG have also considered single cell protein, fish protein concentrate, amino acid fortification of protein foods and the marketing of protein foods for vulnerable groups.

A meeting of a PAG working group in Washington last October examined the whole problem of the significance of lactose intolerance for feeding programs using milk. Some of you may know that it is now quite clear that after early childhood most non-Caucasian populations lose the intestinal enzyme lactase which aids in the digestion of the principal sugar of milk, lactose, and in the absence of this enzyme large amounts of lactose will cause diarrhea, flatulence and discomfort. Some individuals have extrapolated from observations with large test doses of lactose to the statement that intolerance to lactose makes suspect the feeding of milk containing lactose to these same populations. The PAG working group took note of the very successful use of milk for preschool feeding and school feeding all over the world under the aegis of UNICEF as well as of the voluntary agencies among the very populations in which low lactase levels after about two years of age have been demonstrated and emphasized the difference between lactose intolerance and milk intolerance. The working group concluded that the existence of low lactase levels in most of the world's populations is not any reason to change policies as to the use of milk in supplementary feeding. There are other reasons for reducing milk in supplementary feeding such as its cost and uncertain local availability and for developing low-cost vegetable mixtures as a substitute for milk, but lactase deficiency is not one of them.

I will close by referring to certain general principles which are so well expressed in the General Progress Report of the Executive Director, the importance of flexibility of programs and their adaptation to individual countries, the need for a unified approach to economic and social development of which nutrition is an important aspect, although only one aspect, with the integration of nutrition into general plans for social and economic development. For a number of years the nutritionists have been knocking on the doors of the planners, usually without being admitted. In the last two years there has been a gradual change in attitude: a conference at MIT on "Nutrition, National Development and Planning" last October brought together top planners from planning commissions, ministers of planning and the like with action-oriented nutritionists from some 53 countries. UNICEF and other organizations were helpful in the support of this conference. Out of it and other similar activities, the involvement of the World Bank was stimulated. The proposed inclusion of nutrition consultants in World Bank missions is going to help gain recognition that the nutritional and health status of the population is an essential part of social and economic development.

The principle of UNICEF aid to strengthen the capacity of countries for action and growth represents an important positive action of the strengthening of countries as compared to the relief or the improvement of the status of individuals. We certainly need more effective low-cost programs for getting at the nutrition problems which we have been discussing. There definitely is a need for increase in the training of competent people at a variety of professional and auxiliary levels in the developing countries and there is a continuing need for institution building. The PAG has appreciated UNICEF's responsiveness to these needs.

Minneapolis, Minnesota, U. S. A.

INSTITUTE OF FOOD TECHNOLOGISTS

The 32nd annual IFT meeting was held from May 21 - 25, 1972, in Minneapolis under the theme "Action - not Reaction - to the Challenge of Change". It was attended by about 5000 participants and 200 technical papers were presented. The meeting was organized in the form of symposia and included topics such as sensory evaluation, carbohydrates, protein interaction, nutrient retention, food problems of developing countries, food service, refrigerated and frozen foods, quality assurance, product recall, computer simulation and food science programs. There were also forums on L. I. F. E. and the IFT, student involvement, personal financial planning and food standards.

The symposium on protein interaction discussed the chemical reactions of ingredients in the complex biosystem occurring in foods. The topics covered were water in biosystems, protein structure and protein-protein, protein-water, protein-lipid and protein-carbohydrate interactions. The two sessions on proteins, as part of the symposium on refrigerated and frozen foods, gave some highlights on recent research on the preparation, characterization and possible use of protein isolates or concentrates from cottonseed, peanuts, corn germ, cheese whey, fish and animal blood. A paper on alternative approaches for the reduction of RNA content in Candida yeast was included.

The symposium on accelerating food technology in developing countries discussed the problems these countries are facing in establishing food technology research institutes, in introducing food science, and in meeting food packaging needs, and also the role of the private sector.

New developments in computer technology can result in several potential applications in the food industry; some of these were discussed in the symposium on computer simulation. The topics included,among others, tailoring mass feeding meals to individual food habits and nutritional needs, and planning manufacturing, distribution, research and engineering. The meeting featured a food exhibition which gave a preview of the latest innovations in commercially-produced new foods and equipment for the food industry.

All papers presented at the IFT annual meeting are considered for publication in "Food Technology" or "The Journal of Food Science".

ACTIVITIES OF THE WORLD BANK GROUP IN THE FIELD OF PROTEIN

by Mr. Harold Graves, Washington, D.C.

1. The Bank attaches great importance to the protein question in particular and to nutrition in general. Mr. McNamara covered both extensively in his address to the Board of Governors of the World Bank on September 27, 1971, and in his address to the United Nations Economic and Social Council on October 28, 1971.

2. At least four different activities of the Bank (and of its affiliate, the International Development Association) during 1971 were of interest from the standpoint of protein. They were: 1) lending for projects which will have the effect of increasing protein availability in developing countries; 2) participation in the PAG; 3) steps toward the establishment of a nutrition division in the Bank; and 4) support for international agricultural research which will increase protein availability.

3. During the period being covered by the Secretary-General in his own consideration of the protein question - the calendar years 1970 and 1971 - the Bank and IDA made 18 loans and credits in 15 countries to help finance projects which should increase the production of food with high protein content. Of these transactions $8.9 million worth were made to benefit fisheries production in Indonesia, Panama and Tunisia; $4.4 million were made to benefit dairy development in Ethiopia; and $134.0 million were made to benefit livestock production in Bolivia, the Dominican Republic, Ecuador, Guatemala, Guyana, Honduras, Jamaica, Korea, Mexico, Turkey and Uruguay.

4. Toward the end of 1971, the Bank became a sponsor of and financial contributor to the FAO/WHO/UNICEF Protein Advisory Group, which thereafter became known as the Protein Advisory Group of the United Nations System. The Bank thereby became the first agency to respond to recommendations for broadening the sponsorship of PAG.

5. At about the same time, the Bank began a series of consultations with the United Nations and with the specialized agencies to learn more about their activities in the field of protein and nutrition, with the view to the cooperative development of Bank and IDA activities in this field. (This consultation was completed in January 1972; and, as a sequel, the Bank is establishing a unit in one of its operational departments which will be concerned with financial and technical assistance to nutrition projects and programming in developing countries.)

6. Together with UNDP and FAO, the Bank is a sponsor of the Consultative Group on International Agricultural Research, whose activities have a bearing on the protein question; the Bank serves as Chairman of the Group. The Consultative Group is composed of 27 members. Besides the sponsors, there are three private organizations, the Ford, Rockefeller and Kellogg Foundations; twelve donor governments, Belgium, Canada, Denmark, France, Germany, Japan, the Netherlands, Norway, Sweden, Switzerland, the United Kingdom and the United States; three regional development banks, the African Development Bank, the Asian Development Bank and the Inter-American Development Bank; and the International Development Research Center, an autonomous organization financed by the Government of Canada. In addition, the five major developing regions of the world participate in the Consultative Group through representative countries designated for a two-year term by the membership of FAO.

7. A meeting of the Consultative Group in December 1971 had the opportunity to consider the recommendations of its Technical Advisory Committee for financial support to ongoing or new international research programs in 1972. Members of the Group agreed, among other things, to give financial support to existing international centers of agricultural research.

8. One of these is the International Wheat and

Maize Improvement Center, situated in Mexico. A current special program of the Center, supported by UNDP, is devoted to the development of high-lysine maize, which would greatly increase protein availability and utilization among peoples for whom maize is a staple of diet.

9. Three other centers supported by grants from individual members of the Consultative Group: the International Potato Center (CIP), in Peru; the International Center for Tropical Agriculture (CIAT), situated in Colombia; and the International Institute for Tropical Agriculture (IITA), in Nigeria; have programs which are of interest from the standpoint of protein availability. CIP is working, for example, to increase the adaptability of the potato to new ecological zones, CIAT is working to improve the output and quality of beef, swine and field beans, and IITA is seeking to develop higher-yielding varieties of grain legumes, specifically cowpeas, soybeans, pigeon peas and lima beans.

10. A new center which will be established under the sponsorship of the Consultative Group to conduct research to improve farming systems in semiarid tropical zones likewise promises to increase protein availability. This center, to be called the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), will be established in India. At the outset, it will be concerned, among other crops, with two legumes of high protein value; namely, chick peas and pigeon peas.

11. The Consultative Group in 1971 also set in motion a number of studies. Two are intended to develop recommendations concerning research to improve the output of livestock, and especially of beef, in Africa; and this, too, would materially add to the resources of protei in developing countries. The Group's Technical Advisory Committee has signified its intention of studying the potentialities of aquaculture as a subject of international research, and will be making an inquiry to determine what part international research might play in helping to develop higher-yielding, higher-protein varieties of legumes. The presence of these studies on the Committee's agenda suggests that the interest of the Consultative Group in protein not only will continue by may intensify.

PAG RECOMMENDATIONS FOR THE PROMOTION OF PROCESSED PROTEIN FOODS FOR VULNERABLE GROUPS

To aid in developing this statement (No. 23) the PAG convened a meeting of leading pediatricians and representatives of the food industry in Paris, France, 16 and 17 June, 1972. In its deliberations this group took note of a preliminary meeting of pediatricians and the food industry which was convened in Bogota, Colombia, in November 1970 by the Pan American Health Organization/World Health Organization and UNICEF at the suggestion of the PAG. Note was also taken of the recommendations of a workshop on nutrition for "new urban families" held by the International Pediatrics Association in Vienna, 28 August 1971. Among the topics discussed at the June 1972 meeting were: purchasing power of African and Asian consumers in relation to meeting the nutritional needs of the child through commercial channels; problems facing governments in stimulating the supply of nutritious foods and supplements for infants and young children; role of industry in providing low-cost, nutritious foods for infants and young children and problems related to marketing and promotion practices of foods for infants and young children.

The PAG is grateful to those who have contributed to these efforts.

Summary

The statement emphasizes the critical importance of breast feeding under the sociocultural and economic conditions which prevail in many developing countries. Infants of more affluent socioeconomic groups in industrialized and developing countries, in the absence of breast feeding, suffer no disadvantage when fed properly-constituted and hygienically-prepared processed commercial formulas. However, the early abandonment of breast feeding by mothers among lower socioeconomic groups can be disastrous to infants, particularly when this occurs without knowledge of the resources and hygienic practices necessary to feed their infants adequately and safely with breast milk replacements. Under such circumstances and where animal milk as a supplementary protein resource is expensive or in short supply, an important function of the food industry, in close cooperation with governments and physicians, should be the development and marketing of relatively low-cost nutritious protein foods which fulfill the nutritional role of milk among more affluent societies.

To assist the various interests concerned with these problems to deal with them objectively and effectively, the PAG proposes three sets of coherent recommendations: one for governments and United Nations agencies, a second for pediatricians, physicians and others caring for children, and a third for the food industry.

1. Introduction

The widespread occurrence of protein-calorie malnutrition among infants and preschool children of developing countries has been extensively documented (1) and its consequences in increased morbidity and mortality, impaired physical growth and effects on learning and behavior emphasized. The high incidence of inadequate nutrition during pregnancy and lactation in these countries also contributes to malnutrition of the infant and debilitation of the mother.

Breast milk is an optimal food for infants and, if available in sufficient quantities, it is adequate as the sole source of food during the first four to six months of age. After this time the family diet should be gradually introduced. In underpriviledged groups, poor health and adverse social circumstances may decrease the output of milk by the mother, while frequent infections increase the needs of the infant for protein foods. In such circumstances supplementation of breast milk with nutritionally adequate foods must start earlier than four to six months if growth failure is to be avoided.

The inherent availability of breast milk and its nutritional, biological and sanitary quality makes breast feeding eminently desirable and under the sociocultural and economic conditions of many populations in developing countries it is of critical importance. Every effort to promote breast feeding should be made through education of the population and by emphasis both in the training of professional, para-professional and volunteer health personnel and in the planning of a national food and nutrition policy.

Among more affluent socioeconomic groups in both developing and industrialized countries, children who are fed a properly constituted and hygenic infant formula instead of breast milk suffer no apparent disadvantage. Processed infant foods which are nutritionally complete when properly used are widely available. Among lower socioeconomic groups, however, the abandonment of breast feeding can be disastrous because alternative traditional practices tend to be unhygienic and nutritionally inadequate. Under such circumstances breast feeding should be maintained if it is at all possible to do so. Unfortunately, women migrating from rural to urban areas tend to abandon breast feeding in imitation of higher income mothers or in order to work, without having either the knowledge or the resources to feed their infants adequately without the use of breast milk.

It is this situation which poses a dilemma for the food industry. It is clearly important to avoid any action which would accelerate the trend away from breast feeding; at the same time, it is essential to make available to the mother the foods, formulas and instructions which will meet the need for good nutrition of those infants who are not breastfed for various reasons.

The problem of meeting the special needs of children from birth to five years of age and pregnant and lactating women is complicated by the fact that animal milk, which is a major supplementary protein source for these groups in industrialized countries, is generally in short supply, of poor quality or costly for most of the population of the developing countries. For them there is an urgent need for the development and marketing of relatively low-cost protein foods which fulfill the nutritional role which milk plays in more affluent populations.

The production and marketing of appropriate and nutritious food suitable for infants and young children and for pregnant and nursing mothers is an important function of the food industry. However, special problems are faced in the developing countries which require both close liaison and cooperative efforts among industry, government and physicians concerned with the care of mothers and children as well as nutritionists and public health workers. These problems revolve around low educational and economic levels and often environmental conditions making hygienic handling of products difficult. Most food industry leaders welcome opportunities for such collaboration.

It is clear from the foregoing that the development and introduction of processed protein-rich weaning foods for the supplementary feeding of breast-fed infants and children after weaning and for use by expectant and nursing mothers is of major importance for any country in which there are not now satisfactory products available. However, the effective marketing, distribution, acceptance and proper use of these products in harmony with national needs and traditions requires the coordinated efforts of governments, international organizations, industries, health, educational and social agencies and medical personnel.

In order to guide industry, governments, international agencies, physicians and nutritionists in dealing with these issues the following principles are recommended.

2. Recommendations to governments and United Nations agencies

2.1 Governments should recognize infant and child malnutrition as an urgent problem and should be encouraged to give immediate support to studies and surveys, in cooperation with nutritionists, pediatricians and concerned industries, which will define the magnitude and nature of this problem.

2.2 Governments should give high priority to food and nutrition in development planning, and should seek the collaboration of industry which could contribute to planning for nutritional improvement. Special attention should be given to utilizing the potential of local food industries based on local supplies and to stimulating the establishment of new local ventures for the production of nutritious foods for the nutritionally-vulnerable segments of the population.

2.3 Governments should accept the fact that fostering new food innovations for nutritional improvement will demand urgent action to provide fiscal and financial incentives which will encourage industrial investment.

2.4 Governments should be encouraged, with the advice of pediatricians and nutritionists, to adopt nutritional criteria in facilitating the provision of processed foods for infants and young children in the commercial market. This can be done by rationalizing legislation and by simplifying administrative procedures which affect the infant and the weaning food trade.

2.5 Governments should take the following steps to assist the introduction of nutritious foods for infants and young children at the

lowest feasible cost:
a) initiate specific legislative action to reduce direct and indirect fiscal burdens on processed infant and weaning foods.
b) consider subsidy programs to provide nutritious protein-rich infant and weaning foods to the most vulnerable and the lowest income groups. In some situations, governments should provide also for free distribution of supplementary foods to the vulnerable groups in the lowest income families.
c) provide strong support in organizing and financing educational programs to establish correct product usage, including situations where the products are provided free or at low cost. Such programs should be carried out in close collaboration with physicians caring for mothers and children and with the industry involved. Maternal and child health centers and mother-craft and nutrition rehabilitation centers should be recognized as useful channels for this educational work.
d) stimulate use of mass media channels for both educational and product promotion communication.
e) encourage recognition of promotion as an essential component of any marketing program to establish widespread consumer use of nutritious foods for children. For approved products, governments should give active support to promotion programs, including, where possible, financial assistance as well as provision of trained personnel and communications facilities through health services.

2.6 The organizations of the United Nations system should continue to encourage the developing contacts between government officials, medical and other health personnel and industry, and to support, through appropriate channels, such as the FAO-Industry Cooperative Programme and the PAG, more extensive examination of outstanding problems of concern to both sectors.

2.7 The United Nations agencies should continue to pursue their initiatives to conduct seminars, workshops, and other training opportunities for personnel of developing countries on technical approaches to development, testing, marketing and promotion of processed infant and weaning foods and other nutritionally desirable foods.

3. Recommendations to pediatricians and other physicians caring for children

3.1 Pediatricians should foster educational programs for all health personnel, stressing the importance of breast feeding especially under six months of age.

3.2 Physicians caring for children, as well as nutritionists, should support ventures to launch protein-rich foods of plant origin to be used where traditional high-quality food resources such as milk are unavailable or beyond economic means. In preparing educational material, properly formulated protein-rich foods of plant origin should be recommended with those of animal origin for meeting protein needs.

3.3 Physicians caring for children, as well as nutritionists, should recognize the pressing need to introduce nutritious foods for infants and young children at the lowest feasible cost and the opportunities for cooperating with industry under mutually-acceptable standards to achieve improved nutrition, particularly in developing countries.

3.4 Pediatricians should be encouraged to conduct round tables and seminars to inform themselves and keep up with developments in infant and child feeding, including the promotion of breast feeding, and use of home-prepared weaning foods. The availability of various new and existing processed foods, including foods to meet special pediatric needs, should also be discussed.

3.5 Pediatricians and representatives from the food industry should hold meetings to discuss their respective interests and needs and progress in the field of infant and child feeding.

4. Recommendations to industry

4.1 Food industry leaders should be involved constructively in the solution of the special nutritional problems of vulnerable groups, particularly in developing countries.

4.2 The importance of breast feeding should be stressed in employee training and personnel instructed not to discourage appropriate breast feeding in any way.

4.3 Industry should train its personnel adequately in matters concerning local public health norms, needs and regulations in the implementation of national food and nutrition policies.

4.4 Industry should recognize and emphasize that the immediate postpartum period and the hospital nursery are not appropriate for any promotion of infant foods directed at other than professional personnel.

4.5 Industry should give special attention to the importance of unambiguous and standard ways of making up dry and liquid preparations for child feeding to minimize misuse. The needs of illiterate as well as literate persons should be considered in designing labels. Label design and literature should foster hygienically-oriented practices such as the use of boiled water and the proper cleansing of utensils.

5. Reference

1. Bengoa, J.M. 1970. Recent trends in the public health aspects of protein-calorie malnutrition. WHO Chronicle 24, No. 12:552-561.

PAG GUIDELINE 11 FOR THE SANITARY PRODUCTION AND USE OF DRY PROTEIN FOODS*

This document specifies the following for dry protein foods:

The basic requirements for food processing factories suitable for manufacture of such foods;

The microbiological criteria of acceptance to be applied to the finished product;

Precautions to be observed during and after reconstitution of the foods; and

Methods of analysis and sampling plans are specified for determination of aerobic plate count, coliforms, and coagulase-positive staphylococci.

Introduction

Microbiological testing is an integral part of quality control in the food industry and is a major tool of regulatory and health agencies in securing food safety and discovering the sources of specific outbreaks of food-borne disease. Increasing recognition of the role of foods in causing disease and the large and growing quantities of foods in international commerce underscore the need for application of effective analysis.

The validity of deductions to be made from any microbiological analysis of food is dependent inseparably upon the sensitivity and reproducibility of the analytical method, and upon the associated probabilities of acceptance and rejection inherent in the sampling plan used. Comparative judgements of different

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* The contribution of Dr. F. S. Thatcher, Chairman, International Commission on Microbiological Specifications for Foods, to the development of this guideline is acknowledged.

analyses are only justifiable if the same methods and sampling plans are used in each instance. To obtain this requires the use of internationally acceptable methods of analysis and of sampling.

The major concern in this particular guideline is safety of the food and assurance that it has been manufactured under sanitary conditions. The microbiological parameters chosen are those which a) are considered collectively to assure a high level of safety when the recommended limits are attained, b) have been shown, during several years of analysis, to have been commercially attainable, and c) represent a series of analyses which can reasonably be performed by a laboratory competent to present data adequate for judgements on acceptability or rejection of large quantities of valuable foods.

The recommended parameters and their respective functions are listed below.

1. Aerobic plate count
Function:
a) an indication of processing adequacy, and
b) occurrence of conditions which have allowed significant microbial proliferation within the food.

2. Fecal coliforms
Function:
an indicator of post-processing contamination which, if severe, indicates faulty sanitation control in the plant. Such conditions of manufacture are those more likely to provide pathogenic contaminants and particularly those of enteric origin.

3. Coagulase-positive staphylococci
Function:
a) as an indicator of post-processing contamination arising from faulty sanitation control with particular reference to unhygenic practices by the workers which may have contributed contamination from nasopharyngeal or superficial suppurative foci;
b) to demonstrate a potential to cause staphylococcal food-poisoning
(i) from existing enterotoxin if large numbers of staphylococci are present, and
(ii) if the food is treated abusively after reconstitution.
Without such abuse the disease significance of small numbers of staphylococci in dried foods is practically none, unless processing had destroyed Staphylococcus organisms present in grossly-abused raw material in which toxins remained.

4. Salmonella

Function: to determine the presence of any member of the pathogenic genus Salmonella, and hence the risk that a Salmonella-contaminated food could cause the disease salmonellosis. This enteric infection may be of varying severity, but is most severe within the populations most likely to consume the foods under discussion. The risk is increased if abusive treatment after reconstitution allows multiplication of salmonellae.

Specific recommendations to assure acceptable microbiological quality in dried protein foods

1. Safe production

Plant, facilities and operating requirements.
Dried protein foods shall be manufactured in an establishment which
a) satisfies systematic sanitary inspection by a competent government agency (hereafter, the Agency), and
b) meets the recommendations of the General Principles and Guidelines of the Food Hygiene Committee of FAO/WHO Codex Alimentarius with respect to equipment, design, in-plant and environmental sanitation, hygiene of workers and quality control practices.

2. Ingredients for manufacture

Suggestions for microbiological criteria of acceptance for some of the ingredients that might be used in the dried products in question are listed in Table I.

TABLE I. MICROBIOLOGICAL CRITERIA OF ACCEPTANCE FOR INGREDIENTS TO BE USED IN DRY PROTEIN FOODS

Ingredient	Plan Class	Test	Method Ref.[2]	n	C	Limit per g	
						m	M
Cereal grain derivatives (flours, starches)	3	SPC	64	5	2	10^5	10^7
Fish protein concentrate and protein concentrates from animal and vegetable sources	3	SPC	64	5	3	10^5	10^7
	3	Salmonella	90	13[1]	0	-	-
Dried milk	3	Staphylococcus	115	5	2	0	10
	3	SPC	64	5	1	$5\text{x}10^4$	$2\text{x}10^5$
	3	fecal coliforms	77	5	2	0	10
	2	Salmonella		60[1]	0	-	-
Nuts	3	SPC	64	5	3	10^6	10^8
	2	Salmonella	90	13[1]	0	-	-

Some caution is needed in their application. Developing countries, perhaps more than others, need to avoid unprofitable analyses. Confidence in a specific supplier based on
i) his own protocols,
ii) experience of food quality from initial analyses or complete satisfaction in "performance" of products from a particular source factory: each could be cause for a "spot-check" system to examine, say 1 in 5 or 1 in 10 shipments unless a sizeable routine analytical laboratory is available. If the finished product is shown to be substandard and the quality of ingredients needs investigation, then analysis should be more intensive than the sampling plans listed.

3. Microbiological specifications for the end-product

The specifications which follow are summarized in Table II, page 17.

Whenever a sample is to be obtained for microbiological analysis it is imperative that every possible precaution be taken to prevent adventitious contamination of the sample. This will require the use of sterile

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[1] All above Salmonella tests are subject to compositing of the sample units.

[2] This column refers to the page numbers in the ICMSF text where the specific methods are described. "Microorganisms in Foods: Their Significance and Methods of Enumeration", Thatcher and Clark, 1968. University of Toronto Press, Toronto, Canada or Oxford Press, England. This text will henceforth be referred to as Ref. 1. ICMSF is the International Commission on Microbiological Specifications for Foods and it is a standing commission of the International Association of Microbiological Societies.

TABLE II. RECOMMENDED SAMPLING PLANS FOR MICROBIOLOGICAL EXAMINATION OF DRY PROTEIN FOODS

Organisms	Method	Sampling Plan					Acceptance criteria	Probability of accepting substandard lots 1)
		Class	n	M	m	c		
Aerobic plate count	ICMSF p. 66 2)	3	5	2x10^5	10^4	2	no sample to exceed 2x10^5, not more than 2 samples to exceed 10^4/g	P(5%)max 3) = 0.77 med 4) = 0.35
Coagulase-positive staphylococci	ICMSF Method I p. 115 or Method V p. 121	2	5	10	10	1	not more than 1 sample to exceed 10/g	P(5%) = 0.98 (50%) = 0.19
Fecal coliforms	ICMSF MPN procedure No. 1 p. 72	3	5	21	11	2	no sample to exceed 21/g, not more than 2 samples to exceed 11/g	P(5%)max = 0.77 med = 0.35
Salmonella	ICMSF Method IV p. 96	2	60	0	0	0	no sample to be positive for salmonellae	P(5%) for 1 cell in 500g = 95%

ICMSF International Commission on Microbiological Specifications for Foods

1) Figures in brackets represent the proportion of the lot actually in excess of the standard.

2) Page numbers refer to the pertinent page in the ICMSF text: Microorganisms in Foods: Their Significance and Methods of Enumeration, Thatcher and Clark, 1968, University of Toronto Press, Canada; Oxford Press, England.

3) P(5%)max = the maximum possible acceptance which occurs when no samples are marginal, i.e., at the limit.

4) P(5%)med = the acceptance at the condition when 50% of sample units have values within the range m-M. (After Bray three-level plan).

sampling equipment, sterile containers, and an effective means of preventing damage during transport or shipment. The samples should be obtained by a person with at least a working knowledge of asepsis and of potential sources of contamination under the conditions where the sampling is to be done.

3.1 Aerobic plate count.

Sampling plan: 3-class, n = 5, c = 2; M = 200,000/g, m = 10,000/g (see Addendum I which describes the symbolism used in expressing sampling plans).

Analytical method: The "Pour Plate or Standard Plate Count Method" of ICMSF, Method 1, p. 66, Ref. 1.

Procedure: From each lot*, obtain a sample consisting of 5 random specimens, each of 10 g. Keep each specimen separate. Prepare food specimens for analysis as in "Procedure", p. 63, "Preparation and Dilution of the Food Homogenate", Method 2, Ref. 1. Complete Method 1 (p. 63, Ref. 1). Compute the number of mesophilic aerobes per gram of specimen.

Interpretation of results: Reject those lots
a) in which one or more of the 5 specimens exceeds 200,000 aerobic mesophiles per gram;
b) if more than 2 specimens exceed 10,000/g.

3.2 Fecal coliforms.

Because a test for Salmonella should be mandatory, it is recommended that tests for fecal coliforms should be dispensed with, except when
a) available evidence is not sufficient to establish that the product has been manufactured in accord with the requirements of Section I (Safe Production);
b) if the food has been manufactured in areas where enteric disease is of high frequency, and the examining Agency has cause for concern over contamination with enteric pathogens other than Salmonella, such as Shigella, Entamoeba or other zoological parasites, or enteric viruses;
c) if the food is derived from a factory whose products had been involved recently in outbreaks of enteric infection. Since Salmonella can come inherently from the ingredients used in the manufacture as well as from environmental contaminants, Salmonella testing alone cannot be a substitute for testing for presence of fecal coliforms which will provide an indication of the sanitation control in the plant.

Sampling plan: 3-class, n = 5, c = 2; M = MPN 21/g, m = MPN 11/g.

Analytical method: ICMSF, MPN Method No. 1, p. 72, Ref. 1.

Procedure: From each lot obtain a sample consisting of 5 random specimens each of 10 g. Keep each specimen separate. Prepare food specimens for analysis as in "Procedure", p. 63, "Preparation of the Food Homogenate", Method 2, Ref. 1. Complete "Enumeration of Coliforms", Method 2, p. 75, Ref. 1, and proceed to "Determination of Coliform Organisms of Faecal Origin", Method 2, p. 78, Ref. 1. Calculate most probable number (MPN) of fecal coliforms as described on p. 74, Ref. 1.

Interpretation of results: Reject those lots
a) in which any specimen shows an MPN value in excess of 21/g;
b) if more than 2 specimens show MPN values in excess of 11/g.
Note: these criteria show "unbalanced" numbers because they are chosen from MPN tables as nearest to M = 20, m = 10/g.

3.3 Coagulase-positive staphylococci.

Sampling plan: 2-class, n = 5, c = 1; m = 10/g.

Analytical method: The Baird-Parker method as described on p. 115, Method 1, Ref. 1.

Procedure:
a) preparation of the specimen food and its dilution as specified on p. 60 et seq., Ref. 1., and
b) confirmation of suspect colonies or a specified proportion of them by application of the coagulase test, p. 122, Ref. 1.

Interpretation of results: Reject those lots in which more than one specimen is shown to contain more than 10 coagulase-positive staphylococci per gram.

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* "Lot" is described in Addendum II.

3.4 Salmonella.

Sampling plan: 2-class; n = 60, c = 0. (Subject to compositing, n = 3(x20), c = 0. See Note under "Procedure", this section.).

Analytical method: The method preferred for dry protein foods is based on that described as Method IV, "Procedure for Powdered Milk", p. 96, Ref. 1., but modified in the light of the results of international comparative testing by ICMSF.

The modifications are:
1) Primary Selective Enrichment. For the primary selective enrichment use a 25g specimen (not 100g) and adjust the volumes of sterile distilled water and brilliant green dye solution in the same ratio , i.e., use 250ml sterile water and 5ml dye solution.
2) Proceed to secondary enrichment, without inoculation of plates from the primary enrichment. No significant difference between the 5 alternative tetrathionate broths has been demonstrated. Any one may therefore be used, but the simplest version is formula 81, p. 192, Ref. 1.

Procedure: From each lot to be tested obtain 60 randomly chosen specimens of 25g each. Two alternative procedures are now available:
a) to examine each of the 60 specimens separately, and proceed as specified in the method cited above; or
b) to aggregate the 25g specimens into 3 composite specimens of 500g each,i.e. 20 of the 25g specimens. Examine, independently, each of the three 500g composite specimens, adjusting appropriately the volume of sterile distilled water used for reconstitution, i.e., in the ratio 20:1.

Interpretation of results: Any lot in which Salmonella is confirmed in any specimen should be rejected for human use. Even if such a lot receives additional antibacterial treatment and passes all the microbiological tests satisfactorily on reexamination, the reprocessing may have affected the nutritional quality. Salmonella contaminated feed is a critical factor in the Salmonella cycle: feed-animals-food-man and hence the rejected product should be processed to destroy Salmonella before being fed to domestic animals.

ADDENDUM I

A rationale for the selection of microbiological criteria of acceptance for dried protein foods for supplementary use, as proposed in this guideline.

1. The purposes of routine microbiological analyses of foods

Microbiological analysis of processed foods is commonly carried out with four different objectives:

1) To provide an indication of the adequacy of the process given the foods.
2) To determine whether the foods, subsequent to processing, had been held under conditions of moisture content, time, and temperature, which had allowed proliferation of micro-organisms.
3) To establish the probability of occurrence of postprocessing contamination from environmental sources, including human sources. Normally the so-called "indicator" organisms are used for this purpose and with special reference to those indicators which suggest contamination either directly or indirectly from
a) feces (E. coli, coliforms, Enterobacteriaceae, fecal streptococci),
b) the upper respiratory tract or suppurative lesions from man (coagulase-positive staphylococci). These organisms may be used to deduce the occurrence of unsanitary practices within processing establishments, including inadequate hygenic practice among the workers.
4) To establish the presence of specific pathogenic microorganisms and/or their toxins.

For the first two purposes, the aerobic plate count is generally used.

2. Analytical methods and sampling plans

1) Selection of analytical methods and sampling plans: The reliability and validity of the deductions to be made from any microbiological analysis is dependent upon
a) the sensitivity and reproducibility of the analytical method, and
b) the sampling plan used.
Competent technical execution of each is essential. Comparative judgements of different analyses are only justifiable if the same methods and sampling plans are used in each instance. Internationally-acceptable methods of analysis and of sampling are thus essential.

In sampling, the major concerns are to undertake analysis of such a number of randomly selected specimens (samples) as will give an acceptable probability of
a) excluding lots which are actually substandard, and conversely,
b) not excluding lots which are actually within the standard but for which the analytical data might seem to indicate substandard quality.
In practice this is difficult to achieve because of the high cost of examining the large number of specimens necessary to give a very high probability, e.g. 95%.

ICMSF employs three-class sampling plans where some tolerance of an organism or group is appropriate. Essentially, such plans specify a value (M) beyond which a lot will be rejected if any single sample exceeds such a value, and they also specify a lesser range of values (m to M) within which one or more samples (c) would be acceptable. The value "m" represents the number of organisms below which no basis for concern exists. A three-class plan has advantages as compared with other plans. It is more clearly aligned to practical experience, where an occasional test in an otherwise good product may appear to give a high value; a higher acceptance probability is obtained with fewer samples; and the extreme value can be selected to relate to a known public health hazard or to known attainment within commercial experience. Such plans are recommended for indicator organisms.

The acceptance probabilities* of a sampling plan for organisms of high importance, e.g. serious pathogens like Salmonella, should be greater than the probabilities for less significant organisms, assuming that economy is critical in the cost of testing operations, as is normally the case. This means more tests should be performed for an important pathogen than for an indicator group. It is necessary to appreciate that the probability of acceptance of a substandard lot is also conditional upon the distribution pattern of the test organism throughout the lot. If a large number of samples have values less than, but close to, the postulated limit, the probability of acceptance of such a lot is much less than if few are close to the limit. This is illustrated by reference to Dr. Bray's data (Figure 1) for one particular sampling plan (3-level, n = 5, c = 1). For this reason, in the present report, two probabilities are specified for each cited sampling plan:
a) the maximum probability as attained when no or few samples within the lot would be at the "marginal" value, and
b) when 50% are marginal.
In practice, most lots from experienced manufacturers would range between these values. In the example given, the probability of acceptance of a lot when 5% of the total samples within a lot would actually be in excess of the standard is 77%, when the number of samples close to the limit is 0; and less than 12% when 50% of the samples are at, or close to, the limit. This means that for a given food, the likelihood of acceptance of a substandard lot decreases as the median value of samples approaches the limit.

2) The importance of sampling plans: in the past, effective sampling plans for routine microbiological analyses have been used infrequently. Their importance should be better appreciated.

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* Courtesy Dr. D.F. Bray, Food and Drug Directorate, Ottawa, Canada.

FIGURE I

n = 5, c = 1

PER CENT BAD	0	10	20	30	40	50	60	70	80	90
5	.77	.70	.55	.38	.23	.12	.05	.01	<	
2	.90	.83	.66	.47	.29	.16	.07	.02	<	
70	<	<								
60	.01	.01	<							
50	.03	.02	.01	<						
40	.08	.06	.04	.01	<					
30	.17	.14	.09	.05	.02	<	<			
20	.33	.29	.21	.13	.06	.02	.01	<		
10	.59	.53	.41	.27	.16	.07	.03	.01	<	
0	1.0	.92	.74	.53	.34	.19	.09	.03	.01	<

PER CENT MEDIUM

AN EXAMPLE OF PROBABILITIES FROM A THREE-CLASS SAMPLING PLAN APPROPRIATE FOR CERTAIN APPLICATIONS TO MICROBIOLOGICAL TESTING OF FOODS (After D. F. Bray)

Probabilities of acceptance of lots containing proportions shown for a sampling plan based on testing of five samples and a tolerance of one sample being greater than a specified value (n = 5, c = 1).

Vertical axis: the proportion (%) of the total samples within a lot which actually exceed the standard.

Horizontal axis: the percentage of the total samples within a lot having a value approaching (or equal to) the limit. This could be called the per cent-marginal within the lot.

Importance: The application of a defined sampling plan, emphasizing a standard analytical method, removes much of the uncertainty that prevails when inadequate or unknown sampling plans are used. However, it must be appreciated that no feasible sampling plan (short of testing the whole lot) can give complete assurance of the absence of a specified organism. Sampling plans with specified acceptance values therefore assume that the risk involved in accepting a substandard lot is of an acceptable probability, or is at the limit of economic feasibility. If an authority accepts a lot that has been demonstrated as substandard by an acceptable sampling plan, in effect he discards the intended probability of safety. Normally, this is more imprudent when concerned with an infective pathogen than with indicator organisms, but note of this factor has been taken in developing the present sampling plans, which are less exacting for indicators than for Salmonella.

If a decision is reached on the basis of one or very few samples it is only validly indicative of the lot if the acceptance value is 0 and the finding is positive. For indicator organisms this does not apply and a single sample might reveal numbers anywhere within the distribution range. Thus, the practice of accepting or condemning a lot on the basis of only one sample is unrealistic in such cases. If such data should be used, then either a very wide latitude in interpreting the laboratory result is logical, or else the "standard" must be placed at a very high level, i.e., at or beyond the extreme value of the expected distribution in a normally-acceptable lot. The 3-class plan goes far to obviate the need for such unscientific practice. A 2-class plan is commonly used for pathogens where it is not desirable to express a range of tolerance.

The 3-class plan has another practical value. It allows an authority to notify a manufacturer of the desirability of in-plant testing if sampling reveals a trend to increasing numbers within the m-M range, hence reducing the likelihood of need for more drastic action in the future.

Examples of sampling plans: In this document the sampling plan is identified by class (2-class or 3-class plan) and by use of the symbols referred to above. For example, the expression "3-class; n = 5, c = 2, M = MPN 21, m = MPN 11", means: a 3-class plan is used and the probabilities of acceptance will be those peculiar to such a plan (3-class); the number of randomly obtained specimens constituting a sample is 5 (n = 5); "c" is the maximum acceptable number of specimens having analytical values between two specified limits, M and m; in the example c = 2, M is the value which, if exceeded by any specimen within the sample, will be cause for rejection of the lot. In the example given, M is the MPN value of 21/g and m is the value below which no concern is expressed; in the present example this is MPN 11/g. Hence, a 3-class plan expresses a completely intolerable number ($>$ M); a number expressing complete satisfaction (m) and a range between M and m where a specified number of analytical results will be "tolerated".

Similarly, "3-class; n = 5, c = 2; M = 200,000/g, m = 10,000/g", states that the probabilities of acceptance are those of a 3-class plan which specifies analysis of 5 specimens, that the lot is acceptable when no single analytical result exceeds 200,000/g, and that no more than two results shall be within the range 200,000/g to 10,000/g.

A "2-class plan; n = 5, c = 1, m = 10" means that the probabilities of acceptance are those of a 2-class plan in which 5 random specimens are examined, and the lot is acceptable if not more than one exceeds the value of 10/g. Note: in the 2-class plan there are only 2 categories of analytical results, satisfactory and unsatisfactory, and based on one specified limit; n = 60, c = 0 specifies a 2-class plan employing 60 specimens in the sample, and the lot is acceptable when none of the specimens is demonstrated to contain the test organism.

3) Factors affecting the selection of microbiological criteria of acceptance

Quality control in the factory: The most critical site for effective control of the microbial content of processed foods is within the factory. Good commercial practice requires that effective control be exercised over the inspection and maintenance of equipment and the overall practice of sanitation, as well as the application of systematic control tests for quality at critical points in the processing scheme and of the finished product.

The relative susceptibility of the expected consumer. It is generally assumed that the populations most susceptible to enteric infection, or in which the expression of the disease is most serious, and to whom the most serious sequelae from food poisoning (enterotoxicosis) may be expected, are the very young, the very old, and those recuperating from other disabilities including malnutrition or harsh exposure.

It is assumed that much of the dry protein food under discussion will be directed to just such populations. Therefore, control should be sufficiently exacting to reduce disease risks to a low probability.

It is recognized that conditions may sometimes exist where a large part of the consuming population may already be carriers of enteric pathogens such as Salmonella. Prediction of the effect of intake of additional salmonellae is problematic. Immunity or resistance to a particular serotype may not always be effective against other serotypes. Precaution for safety should prevail.

Past records of microbiological criteria. A knowledge of past records of the microbiological content of the foods under study should be a weighted factor in assessing the actual acceptance criteria, since the good manufacturer still offers the best guarantee for minimal disease risk. Nevertheless, when it is known that a particular food, or any of its ingredients, has a significant record of containing a particular pathogen, then effective analysis is essential for the organism concerned; for example, Salmonella from meat, soy meal, and milk products and Clostridium botulinum type E from fish products. Powdered foods containing either of these organisms are very likely to contribute to hazards of "cross-contamination" within a plant or to lead to environmental contamination which is often difficult to locate and eradicate.

The dry protein foods under discussion should all receive direct analysis for Salmonella. Examination of the fish protein ingredient for Clostridum botulinum is desirable at least until substantial experience shows failure to recover this organism. Analysis for Cl. botulinum on a routine basis is not recommended because
a) too few laboratories are appropriately equipped or experienced and
b) results available from the few which are show little evidence to anticipate hazard from Clostridia in several types of dried emergency foods.
However, it is desirable that fish protein concentrates be examined by the manufacturer or the Agency for a sufficient period of time to determine the frequency of occurrence of botulinal spores.

The significance of particular organisms in foods. The particular species or groups of microorganisms to be tested is a matter of informed judgement depending on the types of hazards to be anticipated from different classes of foods, the likelihood of microbial proliferation during storage or after reconstitution, and the assumptions made relative to the meaning of the presence of specific organisms or of numerical estimates of them.

The present proposals, therefore, are to use the following parameters: aerobic plate count, coliforms (with the limitations proposed in section 3.2 "Microbiological Specifications for the End-Product, Fecal Coliforms"), coagulase-positive staphylococci, and Salmonella. Clostridium botulinum should be determined, tentatively, for a fish protein ingredient, for the reason already given.

The group Enterobacteriaceae is of much current interest as an alternative to coliforms and as an aid to reduce the workload for analysis for Salmonella. However, ICMSF withholds recommendation of the Enterobacteriaceae test until its sensitivity is shown to be equivalent to the prevailing Salmonella tests. Some doubts have been raised and comparative tests are planned. For this reason an Enterobacteriaceae test is not proposed at this time. Also the reduced workload aspect is now more directly accomplished by the aggregation of samples as proposed in section 3.4 "Microbiological Specifications for the End-Product, Salmonella, Procedure".

ADDENDUM II

Definition of a lot as applicable to this guideline

A "lot" refers to an identifiable unit of production of a particular food normally identified by a food manufacturer by a specific "lot number". The lot number is a code which allows identification of the food in relation to some aspect of production, such as the end product of a particular mixing operation, use of different formulations, a time interval in the production schedule (for example, hourly, daily, a work shift, an interval between "breaks" for the working crew, an interval between "clean-up" operations, or some other time interval proposed by Quality Control or Production Management). The time intervals are often associated with a particular production line, a retort or some other critical item of equipment.

Such a "lot" may include large numbers of small packages, boxes, bags, drums or cartons, all marked with the same lot number, or if a bulk product, may constitute one or more truck- or car-loads. A consignment may contain a number of lots. Where feasible, each lot should be sampled and analyzed independently in the interests both of safety and of minimizing the extent of any rejection if analysis shows the product to be unacceptable.

If a consignment consists of a very large amount of food not identifiable as separate lots, an arbitrary judgement must be made on what should be tested as though it constituted a lot; for example, each car-load or a large container of many small packages. Small consignments all of the same kind of food, and not identifiable by lot number can only be treated as individual lots, i.e., for analytical purposes, such a consignment is equivalent to a lot. Practically speaking, the 3-class sampling plan applies to any size of lot.

THE POTENTIAL OF FISH PROTEIN CONCENTRATE FOR DEVELOPING COUNTRIES

The following is the second and concluding part of PAG Statement 16 on FPC.

4. Production methods

A number of methods have been examined for making FPC (Library of Congress, 1970) but few have yet reached a commercial scale of operation and very few industrial plants exist. Each process has the potential of making a characteristic form of FPC, with its own set of organoleptic, nutritional, chemical, functional and cost properties.

A summary chart of processes for making FPC which appear to be most developed or studied at this time is attached as Appendix I. In addition to these, alkali digestion, acid digestion and combinations of these with enzyme digestion and solvent extraction have been proposed, but insufficient details are available as to the processes or the characteristics of the resulting products to permit an evaluation. Processes which use fish meal as a starting material are attractive in terms of cost, but any fish meal made for FPC production would have to conform to the food standards requirements of the country concerned. As indicated below, such material has been marketed by a Scandinavian company.

Technology is now available for making FPC by solvent extraction from whole fish or fish meal, although further refinements and simplifications are expected to result from analysis of full-scale production operations just commenced or starting soon. Enzyme methods, while having considerable potential, are less developed; they could result in the production of cheap milk analogues.

5. Economics of production

5.1 FPC from fresh fish

5.1.1 Raw material

FPC, like fish meal, depends for its production on abundant and cheap supplies of fish. Fish meal industries grow up in areas where there are large fish stocks, typically of pelagic fish which appear in shoals and can be captured at low cost. The cost of such fish delivered to a shore plant will vary with the abundance of fish, distance from land, weather conditions, and catching methods. Costs of fish-meal fish vary over a considerable range. At one extreme is the Peruvian anchovy at U.S. $10 per metric ton at current exchange rates; at the other is the Norwegian herring at U.S. $77 per metric ton. (At the latter price it is difficult to see how the production of fish meal could be economic).

One commercial FPC enterprise in Canada estimates its cost of fish at Can. $37 per ton - a rather higher figure than the current Canadian East Coast price of about Can. $24 - for fish for fish meal to allow for the better handling required for FPC fish. A similar premium, e.g. 30-40%, would no doubt be required in other fishing areas.

These figures are for fisheries already developed. For a new fishery in a developing country the costs might initially be much higher while fishing grounds were being opened up, fishing techniques worked out and fishing-boat crews trained.

5.1.2 Production costs

Factors affecting production costs can be divided into three sections:

1) Direct costs which vary with the level of production, e.g. cost of fuel, water, solvent, packing, etc., and raw material.
2) Fixed costs which do not vary with production, e.g. labor, insurance, maintenance, management, amortization of capital and interest.
3) Value of by-products, e.g. oil.

The firm referred to in 5.1.1 above expects its cost of production to be approximately 25 Can. cents per lb, of which 10 Can. cents is raw material cost (expected yield about 6.0 - 6.5 to 1) and the balance, processing costs, includes some marketing costs. However, this firm anticipates a 300-day operation when at full production. The experience of shore-based fish meal operations based on fresh fish supplies indicated that 100 days operation is the maximum that can be expected in most circumstances. This firm may be able to truck in fish from other areas of eastern Canada but the target of 300 days looks high. If this is reduced, the cost per ton of product will go up through a proportional increase in fixed costs per ton of product.

If appropriate provision is made for the profit margin which an investor would require to attract him into the business and which must reflect the considerable risks of any fishing venture (e.g. 20 - 25%), an economic selling price of around 35 Can. cents per lb is indicated. This agrees fairly well with findings reported elsewhere (Devanney and Mahnken, 1970) where, with a similar price of raw material, though calculated on a different basis, a price of 24 U.S. cents was reached. A more realistic estimate of days of production annually and provision for marketing costs and profit would then bring the selling price to the same sort of figure. However, a separate study (General Oceanology Inc., 1970a) arrives at a cost to the Chilean economy of hake at 27.2 cents per lb, including profit.

It may be noted that a Scandinavian company has indicated a likely initial selling price of 48 U.S. cents per lb for its FPC product, which probably is of higher protein value than the one referred to above. However, as work is still at the pilot-plant stage, it is not possible to indicate firm production costs at this time. The firm plans to use deboned and eviscerated fish. The cost of this process itself is low; the yield of FPC calculated from whole fish weight is likely to be 8.0 - 8.5 to 1. The company states that the cost of micro-grinding, which may be necessary for some of the markets in developed countries, could add substantially to the price.

A cost of 35 U.S. cents per lb for type A FPC from a large plant may then be a fair guide at present for assessing the potential market for an FPC with no functional properties. Estimates have been quoted of lower cost prices, but, apart from the above-mentioned study (General Oceanology, 1970a) these seem generally to leave no margin for selling costs and profit and make quite unrealistic assumptions as to the number of production days that could be expected in a year.

It must be borne in mind that any potential investor in FPC, whether public or private, must consider the alternative attractions of using the same raw material for fish meal production if not for other food purposes. If the total economic return is higher on an investment in fish meal than one in FPC, it is generally not justifiable to use economic resources to invest in the production of FPC unless specific and substantial reasons are provided in favor of FPC production. The country concerned would probably do better economically if it met the nutritional needs which FPC was intended to cover by producing fish meal instead and using the foreign currency proceeds from its sale to pay for alternative foodstuffs. If there is already a fully-developed fish meal industry, as is the case in Peru and Chile, any FPC project must calculate into the cost of the fish the surplus foregone by diverting the raw material from fish meal. This, at the present time, would be considerable, namely 3-5 U.S. cents per lb of the finished product. The same considerations apply to other competitive uses for fish such as freezing, canning and drying.

So far most FPC projects proposed have been land-based, though one firm is planning to install a pilot plant on a floating factory. If this is successful, it may be extended (Lawler, 1970). The criteria in comparing these alternative methods of operation are the same as for fish meal. Capital and operating costs for a floating factory are estimated to be about twice as high as for a land station. On the other hand, the ability to move with the fish should raise the maximum number of full operating days. The limited experience so far of large-scale floating factory operations of this type suggests that in certain areas, favored with large fish stocks, they can be highly successful, but operators have been cautious in entering this field because of the very high degree of risk. Anyone contemplating an FPC operation on a floating factory would, as on shore, have to compare the economic prospects of this with a similar fish meal operation. An alternative which may show economic advantages lies in the partial processing of FPC at sea. Floating factories are unlikely to appeal to developing countries, since they require large capital expenditure and skilled marine personnel. Extra caution is also indicated because of the tendency of many countries to establish fishing regulations extending fishing limits so far as to seriously interfere with factory ship operations in many areas.

An FPC plant might be planned as part of a fish processing complex engaged in production of frozen fish, canned fish and/or meal or be placed in an area where such other industries exist (Liston and Pigott, 1970). This might allow some economies in sharing of costs and by a rational utilization of raw material. However, FPC will still need its separate plant and it will be necessary to calculate the cost of its material at least at the price which a fish meal plant would be prepared to pay plus a premium for sanitary handling.

In some circumstances, there may be advantages in planning a plant for dual purposes to produce FPC and solvent-extract oilseeds at different times of the year. No details regarding such possibilities are available.

5.2 FPC prepared from fish meal

The quality of FPC made from fish meal may, in certain respects, be lower than FPC made from fresh fish, because the raw material is normally not selected and the process commonly employed changes the properties of the material fundamentally. Against this, production costs are substantially lower than those estimated above, being limited to the cost of the meal plus cost of sieving, defatting and grinding as required for the market concerned. One firm in Scandinavia, which is reported to use raw material fit for human consumption, sells its defatted product prepared under sanitary conditions for animal use at a price about 3 U.S. cents per lb above the price of fish meal; this covers processing costs and profit. At present fish meal prices, the sales price is about U.S. $250 per ton, i.e., 11 U.S. cents per lb. This product goes at present into high-quality animal uses, e.g. trout farms, pet foods, piglets and calf starters. For some of these, calf starters in particular, a fine grind is needed; this can add up to 2 U.S. cents per lb to the cost. Protein content is the same as for fish meal, namely 65 - 72%, and is lower than that of type A FPC. This firm feels that this would be quite suitable as an additive to food for human consumption and have sent trial batches to an African country. It remains to be seen whether this product is satisfactory. The economic advantages of an extraction plant using fish meal as its raw material is that the capital cost is very modest, since most of this is already supplied through the fish meal operation, the technology is relatively simple and the plant can operate throughout the year, fish meal being bought and stored as required for a continuous operation.

It should be noted that conventional fish meal plants and processing methods are not designed for this purpose and could not operate as plants for human foods without the strictest attention to hygiene. The resulting product may require further processing if it is to achieve human food standards.

If a market does arise for FPC in developing countries it seems more likely that it would be for a product in this type range rather than for type A FPC at higher prices.

5.3 New processes

It is suggested that some of the new processes which presently are at an experimental stage offer promise of being fully competitive with solvent-extracted FPC.

6. Economics of consumption

There are two quite dissimilar uses to which fish protein concentrate might be put by a developing country:

a) As a protein supplement for malnourished population groups and particularly for infants and preschool children.

b) As an export which might have greater return than conventional fish meal.

These are two quite distinct aspects, almost certainly requiring different products and probably requiring different processes. If a developing country should decide to divert some of its resources to FPC production, it should be quite clear in which of these uses, or which combination of them, it is investing.

6.1 FPC as a domestic protein supplement

With respect to the domestic use of FPC as a protein supplement for malnourished children, investment in protein nutrition will require the diversion of a portion of a developing country's resources; that is, it will require the developing country to forego the opportunities which could be obtained by alternate uses of these resources.

If a developing country opts to reach a specified level of nutrition in a target group, it should do so by those politically feasible means which minimize the value of the opportunities foregone; in economic terms, by those means which minimize the opportunity cost to the developing society. The state of the art in economics has reached the point where, given the correct inputs, quantitative estimates of the unit opportunity costs of foreign currency, of capital, and of labor of various skills to a particular developing country can usefully be made. The developing country can use such estimates to predict tentatively which of the various alternative protein supplements, both domestic and imported, will allow the target group to reach a specified level of nutrition while requiring the developing country to give up as little as possible, and which of the alternatives is least wasteful. In this respect, it should be noted that the PER and NPU value for the supplement, as measured when the test material is fed as the sole source of protein, is largely irrelevant to its effect on the diet. What counts is the nutritional value of the supplement in the particular diet being supplemented, and this will depend critically on the available amino acid composition of the diet. In short, the relative value of the various supplements can change markedly with changes in the basal diet. Thus, comparisons of nutritional effectiveness should be based on the diet or diets actually being supplemented.

One study now available, based on such comparisons, indicated that, making certain assumptions on quality, acceptability, losses and amino acid availability at currently estimated opportunity costs for type A FPC, this product will rarely be the least costly means of supplementing a diet even in a fish-rich, currency-poor country. This analysis was based on six different isocaloric diets meeting various multiples of the FAO/WHO reference protein requirements for a specified target child. The basal diets studied were pure wheat, pure rice, pure corn, and pure cassava with a corn-based import food, a Chilean and an Indian diet (Devanney, 1971).

The resulting conclusions can at this stage be only indicative in nature since they are based on the costs of various infant food mixtures prior to cooking, packaging and distribution, and did not consider acceptability factors. Further, the amino acid composition of the various foodstuffs was that determined by hydrolysis uncorrected for possible relative differentials in availability and processing losses among the alternatives. In almost every case, this preliminary data showed that if FPC were available at an opportunity cost of 25 U.S. cents per lb, it would be considerably more expensive in meeting various stipulated reference protein requirements than either oilseed or synthetic amino acid admixtures. While this analysis is still incomplete, and can and should be improved, it does indicate that a reduction in the opportunity cost of FPC to about 15 U.S. cents per lb will be required before FPC will be competitive on a predistribution cost basis.

This analysis can also be used to indicate the additional costs to the developing country if it opts to use FPC, rather than the least costly supplement, for other than economic reasons.

As far as domestic use of protein supplements is concerned, scarcity of foreign exchange is a two-edged sword. Importation of supplements involves an expenditure of foreign exchange. In countries where the opportunity cost of foreign exchange is very high, this will, of course, favor domestic supplements. However, investment in FPC will usually involve foreign exchange effects and FPC raw material can generally be exported in the form of fish meal. Thus, an increase in the value of foreign exchange will increase the opportunity cost of diverting this fish to domestic nutrition. Similarly, the importation of processing equipment will involve an expenditure of foreign exchange. In short, in evaluating alternative supplementation strategies, all the effects of foreign exchange must be considered.

There may be situations where a developing country could export its fish resources, receiving in return enough foreign currency so that it could import the nutritive benefit represented by the exported fish and still have some exchange left over. In short, the alternative of importing protein supplementation should not be rejected out of hand.

The primary target of a domestic protein nutrition program, namely the preschool child in malnourished population groups, has no income, no political voice, and almost no discretion as to what he eats. His parents have so little income that an increase in food prices will often be compensated for by a decrease in volume purchased or a shift away from the foods affected. In this situation, it is very difficult to imagine a nutritionally successful program being based completely on private market mechanisms. It may be possible to sell protein supplements in a developing country; however, they will probably not reach the people who need them. The program will be a success only in terms of volume of product moved and not in terms of disease and mortality avoided or mental and physical capacity saved and retrieved. It appears that protein supplementation, in order to be effective, will have to be a subsidized enterprise and it will have to involve a transfer of income to the malnourished child.

There are essentially two possible types of distribution schemes which might be used in a developing country.

1) Some form of universal supplementation in which a staple of the national diet is fortified prior to distribution.

2) Feeding schemes aimed directly at the target group, based on specially-prepared infant and children's foods.

The first scheme has the advantage that the supplement percentages are quite low, this tending in itself to make organoleptic qualities of the supplement less important. Moreover, distribution can proceed through established channels with little additional cost and often very little marketing effort will be required since the consumer will generally be unaware of the fortifying agent. The disadvantages are that, in many cases, people will resist a change in taste of a traditional staple, a well-developed food-processing and distribution system which reaches the target group is required and, most important, the great bulk of the supplement will go to nontarget groups where it will often have little or no effect.

The second choice of strategies has the advantage of focusing directly on the target group but unless they can be persuaded to accept a fishy taste in the foods to be supplemented, it puts severe demands on the organoleptic qualities of the supplement since it may comprise 20% or more of the infant food. This strategy also involves considerable distribution and promotional costs, even if the product is made available to the target group mothers. The decision as to what distribution scheme should be followed is an economically analyzable problem and given the difference in supplement quantities required, this analysis should be carried out before investment in a particular form of supplement is made. Another type of distribution, possibly of use only in countries where people are used to eating fish with spices and other ingredients as traditional "relish", is the sale of FPC through commercial channels.

6.2 FPC as an export commodity

Opportunities are presented to certain developing countries by the growing market in developed countries for upgraded fish meal products and, potentially, for very high quality FPC. It appears that there is a growing market for extracted fish meal of various qualities at prices ranging from 12 to 15 U.S. cents per lb as milk replacers for calves, pig feed and pet foods. The developing countries should follow these markets closely, looking for opportunities to increase foreign exchange earnings by upgrading present fish meal production. In addition, a report by Hammond and Call (1970a) indicates that markets exist and may be growing for a high-quality, functional protein concentrate for use in processed foods in industrialized countries. It may later be possible to tap this very high-priced market. In the present state of the technology, this cannot be anticipated in the near future. However, a developing country should not hesitate to supply such markets if, by so doing, it can increase the real return from its fishery resources. If such opportunities arise, the opportunity cost of diverting raw material to domestic FPC consumption will rise and the relative attractiveness of non-FPC supplements for domestic use will increase.

This is to the fish-rich country's advantage, not disadvantage.

There seems to be little prospect of success for exports of FPC from one developing country to another for purposes of nutritional supplementation until the costs of suitable-grade products have been reduced quite considerably.

7. Conclusions

7.1 FPC should be defined broadly enough to include all stable products fit for human consumption made from aquatic animals in which protein is concentrated, and which are not traditional products.

7.2 A currently suggested classification of FPC's into type A and type B products is not completely satisfactory and it is recommended that changes be made in protein and lipid levels specified for each type. Such a classification can be used with these modifications of the definition, but should be considered only a temporary expedient until sufficient information is available to define each individual product as it may become of importance.

7.3 It is recommended that requirements regarding fluoride content and solvent residues be released from those presently suggested, actual levels required being left to user countries to define. As a guide, maximum levels of 250 ppm of fluoride and 5,000 ppm of isopropanol are suggested.

7.4 Manufacturers should eventually provide definitive specifications for each FPC produced so that users may match the properties of the product to the particular food supplementation needs. These specifications should be derived by standardized test procedures and should include nutritional, organoleptic, functional and safety data.

7.5 Standardized techniques should be developed for the evaluation of the organoleptic and functional properties of different forms of FPC, and be included in a protocol for testing FPC.

7.6 All FPC's should meet the toxicological and microbiological safety requirements for foods of equivalent use in the country of manufacture.

7.7 Since only cheap raw material could be considered for FPC manufacture, the shoaling species would offer the most likely resource. Most of the areas where shoaling species are known to exist in large quantities are already exploited, and some are thought to be overexploited. The relatively few underexploited species are either widely spread or economic catching techniques have not been developed.

7.8 At first sight, the resource potential would appear to allow for a substantial further development of the fishing industries. However, when the status of specific stocks is examined, it can be seen that many which have supported the industrial fisheries in recent years are fully or even overexploited. To maintain the present yield, fishing fleets must shift their efforts to new resources. Many of the new resources are in distant waters or in remote areas. In some cases new catching techniques may have to be developed. It might well be difficult to substantially increase or perhaps even maintain the present level of catch for fish meal production in the near future.

7.9 With the increase in world fish demand and the probable decline in the established supplies of fresh and frozen fish for human consumption in industrialized countries, an increased market for suitable alternative fish supplies may emerge. In view of the much higher value of such fish, diversion of supplies of, e.g. hake to this market would result in a reduction of supplies for fish meal or potential FPC production.

7.10 Although there may be a market for type A FPC in industrialized countries, there appears to be no such market at present in developing countries except possibly for government-sponsored programs as considered below.

7.11 A developing country thus has a choice of two ways of using FPC. It can either produce FPC for its own consumption or it can produce it for export to industrialized countries, if a market in these develops. In making its decision the country involved should make use of quantitative estimates of the unit opportunity costs of foreign currency, of capital and of various labor skills available.

7.12 Any proposal to use FPC in government-sponsored schemes for supplementing the diet of people in developing countries must be evaluated with consideration of the dietary needs and food habits of the target group and of economic and political factors.

7.13 A recent economic study, based on certain assumptions, shows that type A FPC at a price of 25 U.S. cents per lb would not generally be competitive with other protein supplements and the cost of production by presently known techniques is estimated at about 35 U.S. cents per lb. It is, therefore, recommended that developing countries not invest in FPC before they have made a careful economic analysis of alternatives in their specific situations, taking appropriate account of any overriding political or similar considerations.

7.14 Acceptable type B FPC derived from sanitarily-produced fish meal at much lower cost might well be competitive and have a role to play.

7.15 Future FPC research aimed at nutritional fortification should concentrate on producing an acceptable product at a lower cost than presently available techniques have achieved. Less capital intensive alternatives should be given careful consideration.

7.16 Processes now in the experimental stage or just entering the commercial production stage should be watched closely and all possible information made available to developing countries.

7.17 Further economic analyses of the type undertaken at M.I.T. would be of value wherever the relevant input data are available on prices of specific grades of supplements, amino acid availability, losses in production and preparation and acceptability (Devanney and Mahnken, 1970; Devanney, 1971); these should include the use of various alternative protein concentrates but exclude diets which may be considered organoleptically unacceptable. Also, they should be followed by biological tests to verify the cost/nutritional/acceptability data on the most favored options.

7.18 Marketing studies should be carried out to determine the acceptability of type B FPC products that might be made available in particular developing countries. Such surveys should aim at determining also to what extent the vulnerable groups in these countries might benefit nutritionally from the availability of such products.

7.19 There is a need for further studies on the market possibilities for FPC products with desirable functional characteristics. It is likely that such products would be consumed mainly by relatively high-income groups, but work in this area might find application in developing countries.

7.20 Since fish is a relatively inexpensive source of protein, the possibility should be studied of developing inexpensive fishery products which would be acceptable by groups which do not accept the known types of products. The work should be oriented towards processes that would cost in the area of 1 U.S. cent per lb of raw material, since more expensive processes would result in products which would not be competitive in price with other sources of protein. The special needs of products suitable for the weanling and the preschool child should be borne in mind.

8. References

Anon. 1970. A note on the use of fish protein concentrate in Indian food preparations. Mimeographed.

Bagnis, R., F. Berglund, P.S. Elias, G.J. van Esch, B.W. Halstead, and Kohei

Kojima. 1970. Problems of toxicants in marine food products. I. Marine biotoxins. Bull. World Health Org. 42:69-88.

Devanney, J. W. 1971. Generation of minimum cost infant food. PAG Document 2.8/31. FAO/WHO/UNICEF Protein Advisory Group, United Nations, New York, U.S.A.

Devanney, J. W., and G. Mahnken. 1970. Economic aspects of ocean activities. The economics of fish protein concentrate. Report No. MITSG 71-3. Massachusetts Institute of Technology, Cambridge, Mass., U.S.A.

FAO. 1969a. Potential raw material supplies for the industrial production of fish protein concentrates. UNIDO Document ID/WG.48/11. UNIDO, Vienna, Austria.

FAO. 1969b. Nutritional value, utilization and quality control of fish protein concentrates. UNIDO Document ID/WG.48/9. UNIDO, Vienna, Austria.

FAO. 1970. Unpublished data. Food and Agriculture Organization of the United Nations, Rome, Italy.

FAO/WHO/UNICEF Protein Advisory Group. 1969a. Extract of "guidelines for use and evaluation of (US) AID procured fish protein concentrate (FPC)". PAG Document 2.8/24. PAG, United Nations, New York, U.S.A.

FAO/WHO/UNICEF Protein Advisory Group. 1969b. U.S. FDA rules and regulations regarding fish protein concentrate. PAG Document 2.8/25. PAG, United Nations, New York, U.S.A.

FAO/WHO/UNICEF Protein Advisory Group. 1970a. PAG tentative suggestions for fish protein concentrates for human consumption. PAG Document 2.8/26. PAG, United Nations, New York, U.S.A.

FAO/WHO/UNICEF Protein Advisory Group. 1970b. Note on Canadian regulations relating to FPC. PAG Document 2.8/28. PAG, United Nations, New York, U.S.A.

General Oceanology, Inc. 1970a. Commercial feasibility of fish protein concentrate in developing countries. Volume II, Part I. Chile, investment aspects and general summary. G.O. Report No. 12, June 26. Cambridge, Mass., U.S.A.

General Oceanology, Inc. 1970b. Commercial feasibility of fish protein concentrate in developing countries. Volume II, Part II. Chile, background information and supporting data. G.O. Report No. 12, July 21. Cambridge, Mass., U.S.A.

Goldmintz, D., and J. C. Hull. 1970. Bacteriological aspects of fish protein concentrate production. Chapter in Developments in industrial microbiology. American Institute of Biological Sciences, Washington, D.C., U.S.A.

Greenfield, C. 1953. U.S. Patent 2, 651, 647.

Halliday, D., and J. G. Disney. 1970. Fish protein concentrate: a review. Mimeographed.

Hammonds, T. M., and D. L. Call. 1970a. Utilization of protein ingredients in the U.S. food industry. Part I. The current market for protein ingredients. A.E. Res. 320. Cornell University, Ithaca, N.Y., U.S.A.

Hammonds, T. M., and D. L. Call. 1970b. Utilization of protein ingredients in the U.S. food industry. Part II. The future market for protein ingredients. A.E. Res. 321. Cornell University, Ithaca, N.Y., U.S.A.

Kapsiotis, G. D. 1965. The potential utilization of fish protein concentrates with special reference to the Moroccan FPC. PAG Document R.8/Add. 9. FAO/WHO/UNICEF Protein Advisory Group, United Nations, New York, U.S.A.

Lawler, F.K. 1970. Pure fish protein. Food Eng. 42:61-65.

Library of Congress. 1970. Fish protein concentrate: a comprehensive bibliography. Compiled for the National Center for Fish

Protein Concentrate, Bureau of Commercial Fisheries, Fish and Wildlife Service, U.S. Dept. of the Interior, Washington, D.C., U.S.A.

Liston, J., and G.M. Pigott. 1970. Fish protein concentrate. Paper presented at the Third International Congress of Food Science and Technology, Washington, D.C., U.S.A., 9-14 August.

Monckeberg, F. et al. 1970. Practical possibilities for using FPC in Chilean diet. PAG Document 2.8/29. PAG, United Nations, New York, U.S.A.

Rutman, M. and W. Heimlich. 1970. A process for obtaining a highly nutritive soluble fish protein concentrate - a new technological approach. Fisheries Research Institute, IFOP, Casilla 1287, Santiago, Chile.

Sidwell, V.D., B.R. Stillings, and G.M. Knobl. 1969. Analysis, testing and uses of fish protein concentrate. UNIDO Document ID/WG.48/7. UNIDO, Vienna, Austria.

Stillings, B.R. 1970. Protocol of the methods for evaluation of fish protein concentrate. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, National Center for Fish Protein Concentrate, College Park, Maryland, U.S.A. Photocopied.

Zipkin, I., M.Z. Sergio and B.R. Stillings. 1970. Biological availability of the fluoride of fish protein concentrate in foods. J. Nutr. 100:293-299.

Note: Since the publication of this statement, the subject has been thoroughly reviewed in "Fish Protein for Human Foods" by Roland Finch. 1970. Critical Reviews in Food Technology, CRC Press, Cleveland, Ohio, U.S.A.

APPENDIX I

PROCESS	STATUS	PRODUCT PROPERTIES
IPA extraction of whole or eviscerated raw fish or presscake.	Plants operating or under construction in Canada, Sweden and the U.S.A. Technology subject to simplification with experience.	Type A. Neutral, nonfunctional product as now practiced but with possibilities for increasing these at relatively little cost.
EDC azeotropic distillation, followed by IPA extraction.	One plant in the U.S.A.	Type A. Neutral, nonfunctional product as now practiced.
Extraction of fish meal with hexane or IPA.	Plants operating almost exclusively for animal feed. Program for human feeding run successfully in the Union of South Africa for some time, but is now discontinued.	Type B. Nonfunctional product with more odor and flavor than above products, but has been used for food fortification in some areas.
Enzymatic digestion of hake followed by solvent extraction of soluble digest.	One plant proposed in the U.S.A.	Soluble product, slight meaty flavor.
Enzymatic digestion of whole fish, presscake, or fish meal followed by oil separation.	Pilot studies conducted. Process has been used for animal feed.	Product is soluble but not consistently free of fishy flavor.

PROCESS	STATUS	PRODUCT PROPERTIES
Heat-transfer-medium process followed by extraction of centrifuge cake with solvent.	Two plants using process for fish meal in the U. S. A. Extraction process under study.	Product fairly neutral, nonfunctional.
Aqueous and salt separation processes designed to remove soluble protein and some oil from insoluble protein, followed by solvent extraction or stabilization of insoluble protein fraction.	Processes in advanced laboratory stage with some alternatives to be established.	Type A product can produce excellent products, neutral in properties and with considerable functionality. Stability is a problem. Likely to be more expensive than solvent processes.
Mild enzymatic treatment of eviscerated, deboned fish, water-extracted, followed by addition of stabilized fat, pasteurization and spray drying.	Pilot studies conducted in Chile.	Product readily dispersible in water. No fishy flavor, lightcolored, functional.

NEED FOR NUTRITIONAL AND FOOD QUALITY GUIDELINES FOR PLANT BREEDERS[*]

by FAO, IAEA and PAG Secretariat

This document reviews progress achieved and problems encountered by agricultural scientists in the improvement of protein quantity and quality, and processing and consumer acceptance factors, in a wide range of food crops. The establishment of a PAG ad hoc working group to monitor progress and problems in this field and to prepare guidelines for plant breeders, as necessary, is proposed.

The PAG at its 17th Meeting (May 1970) recommended "... that more attention be given in agricultural programs to the use of crop varieties capable of producing more and better quality protein. These crops should include not only the cereals but also grain legumes ...". A PAG Statement (No. 8) on this subject was issued in September 1970 (1). At the 18th Meeting (February 1971) the PAG Steering Committee indicated that the appointment of an ad hoc working group to study nutritional, biochemical and functional guidelines useful to plant breeders should be considered and that information bearing on this need accordingly should be assembled and presented to the 19th Meeting of PAG.

This recommendation of the PAG Steering Committee recognized that notwithstanding the growing worldwide interest and activity of geneticists and plant breeders in improving protein quantity and quality in staple food crops, serious problems have emerged. These relate to the availability and adequacy of rapid and reliable techniques for screening new cultivars not only for potential protein quality in terms of quantitative and amino acid compositional aspects, but also for factors which influence protein nutritional availability as well as desirable technological (processing) characteristics (e. g. bread-making quality in the case of wheat) and consumer acceptance (e. g. texture and color in the case of rice).

It should be noted that these questions have recently engaged the attention of many groups. The International Atomic Energy Agency in 1970 sponsored a symposium which dealt in part with these problems (2) and recently, with financial assistance from the Federal Republic of Germany, IAEA has initiated a coordinated program of research to improve protein content and quality of crops using nuclear techniques for genetic mutation and rapid screening. The U.S. Agency for International Development, which sponsors considerable research in cereal and legume improvement, recently held two meetings dealing with these problems (3, 4), as did also the American Chemical Society (5) and the American Association of Cereal Chemists (6) in sessions which dealt extensively with new chemical and biochemical methodology. The CIMMYT group in Mexico, IRRI in the Philippines, the Swedish Seed Association, the Indian Agricultural Research Institute, several other national agricultural research centers and many university experiment stations are now deeply involved in research related to nutritional and food quality.

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[*] Paper presented at the 19th PAG Meeting, Geneva, December 1971. PAG Document 1.16/5.

FAO, IBRD and UNDP have recently established a joint Consultative Group on International Agricultural Research whose Technical Advisory Committee will doubtless have major concern for these matters. The new Canadian International Development Research Centre is becoming substantively involved in crop improvement research.

The present document does not represent an exhaustive literature review of the problem, but rather a sampling of the opinions and suggestions of scientists and other specialists involved in these activities.

Background

The announcement by Purdue University scientists in 1964 that a mutant gene called opaque-2 in maize varieties causes significant changes in amino acid patterns of corn protein, leading to marked improvement in its biological quality, stimulated worldwide efforts by agricultural scientists to determine whether similarly significant improvements could introduced into other food crops, particularly the cereals, in a manner which would not compromise crop yield and other desirable characteristics. This new interest in protein quality has also revived earlier efforts to increase protein content by genetic means, and it raised the question of whether breeding techniques might not also be effective in modifying or eliminating certain undesirable species-specific constituents from some food crops, which may be toxic or nutritionally deleterious, such as the antibiological and flatulence factors occurring in legumes.

As these rapidly growing efforts have progressed, new problems have been encountered, such as the need for more rapid methods of chemical and biochemical screening of large numbers of mutants for desirable characteristics.

A new screening model is needed for protein quality and quantity, taking into account not only essential amino acids but also the ratios between types of protein constituents (e.g. albumins, globulins, glutelins, prolamins), modification of which is the primary cause of change in overall amino acid patterns. Nutritional availability of these protein moieties should be determined, as well as the applicability of cyto- and histochemical protein localization techniques to this research, and the identification and quantification of second-limiting amino acids and nutritionally important components other than those related to protein.

Progress in breeding is limited by lack of knowledge of the fundamental metabolic mechanisms which control amino acid and protein synthesis in plants. For example, it is known that in wheat, above-average protein content is due to better translocation of nitrogen from leaves to seed due to increased nitrate reductase activity, rather than to more efficient nitrogen uptake from the soil. However, little more is known about this complex biochemical mechanism.

It is also clear that in most breeding programs, especially for cereals, mutants which may have been evaluated for protein content and limiting essential amino acids are usually discarded without evaluation of additional important properties such as better processing quality and palatability.

The comments of specialists are presented in this document in relation to specific crops where such questions have arisen.

Maize

In addition to the deficiencies in opaque-2 maize varieties referred to in a previous PAG document (7)-lower yield, susceptibility to disease (primarily ear rot), impaired processing quality and reduced consumer acceptability - it has recently become clear that the effect of other modifier genes, which cause apparent improvement in limiting amino acid levels as determined by conventional biochemical techniques, may not be matched by actual nutritional improvement when assayed by animal procedures. This has been shown to be the case for the floury-2 gene which stimulates increased lysine levels comparable to those produced by opaque-2 (3, 8).

Opaque-2 maize produced under different environmental conditions can differ significantly in protein nutritive quality, due apparently to differences in lysine availability. It has been suggested that the epsilon amino acid group of lysine is blocked in the floury-2 mutants and is unavailable for animal nutrition. More recently, however, it appears that reagents commonly used for determination of available lysine in proteins give estimates of lysine content for both opaque-2 and floury-2 selections that compare well with those given by column chromatography following acid hydrolysis of the proteins. This result appears to exclude the possibility that much of the lysine is not available owing to the blocking of epsilon amino groups, and suggests that an explanation for these nutritional value variations will have to be sought in digestibility differences related to the physicochemical characteristics of relevant protein fractions (10). Future efforts in chemical screening of maize mutants will clearly require methods for determination of essential amino acids more precisely related to the results of biological test methods.

It is encouraging to note that progress is being made in introducing the opaque-2 gene into vitreous maize varieties having good yield, at the same time retaining the vitreous character and thus satisfying consumer preferences (11, 12).

Sorghum

In a recent review of a major AID-sponsored protein improvement project (13), it was noted that protein digestibility (availability) of a number of new cultivars varied in one study from 30% to 70% and in another from 49% to 77%. In one group of samples PER ranged from 0.18 to 0.90. Startling differences of this magnitude occurred in samples of different varieties with essentially equal protein and lysine contents. The explanation for these observations is not clear, but probably is related to the nutritional blocking and protein nonavailability effects referred to in floury-2 mutants (9, 10) and perhaps to toxic constituents which affect nutritional availability.

Wheat

The currently very encouraging progress at the University of Nebraska in breeding several new wheats with higher protein or of better protein nutritional quality (3, 4, 11) began with prior recognition of the probable incompatibility of increased protein nutritional value with milling and baking quality. Generally, increases in lysine occur in the protein of those tissues which are eliminated in milling (germ, aleurone, scutellum), but even the endosperm, where protein may also be higher in lysine, tends to have soft texture and poor bread-baking quality. However, after establishing the fact that sufficient genetic variability exists in wheat to permit production of mutants with increased protein and others with improved essential amino acid balance, considerable progress has been achieved. After crossing lines with improved nutritional value with others having superior agronomic characteristics, resulting lines have been screened for desirable bran color and endosperm hardness. Those selected are checked chemically for nutritional potential and these are tested for nutritional value in feeding tests with small animals, as well as for technological and consumer acceptance factors.

In low- and high-protein mutant wheat lines produced in Yugoslavia, analyses for the three most limiting amino acids indicated that a high protein content need not necessarily be associated with decreased lysine, methionine and threonine content. Mutant lines of different protein levels did not show any particular changes in relative proportions of Osborne protein fractions (15).

Rice

In current rice improvement studies at IRRI (16), the primary goal is to increase protein content by 2% without affecting grain yield or darkening of rice color. Fortunately, lysine levels tend to increase with total crude protein and thus high protein rice varieties provide higher nitrogen retention in animals and in human subjects than do standard varieties. The lower infant digestibility of rice protein from the outer layers of milled rice is being studied in relation to varietal differences. Texture is influenced by genetically-controlled factors other than protein level (e.g. starch amylose/amylopectin ratio) when the increase in protein is kept to within 2%. IRRI is using dye-binding methods to screen the World Collection of rice for lysine.

A USDA group (17) is determining whether high protein character of some rice varieties with up to 13% protein content is genetically stable, since it is known from limited studies that protein content has low heritability. It is believed that protein content can be increased by 20% to 25% (e.g. from 7% to about 9%) but that efforts to accomplish this improvement can be ultimately justified only when a premium price is paid for rice with this characteristic.

Considerable success has been achieved by Tanaka in Japan by using commercial rice varieties - which generally lack wide variation in protein content - as material for mutation induction, since such varieties generally have good agronomic characters into which to introduce the character of high protein (18).

Barley

While primarily a feed for livestock in the U.S. and Europe, barley is a major food grain in many developing countries, particularly in the Near East. A high-protein, high-lysine line (termed "Hiproly") has been found in the World Collection by Swedish workers, who are now using it as a parent in crossings to raise yield without loss of protein content and quality (19).

In mutation breeding work in Denmark, three lines having about 15% more lysine in their protein than the control were selected by analysis of about 500 mutant lines. The increase in nutritional value was less than expected from the increase in lysine content (20).

Legumes

In proposing acceleration of research on food legumes, the Rockefeller Foundation (21) points out that with the exception of beans (Phaseolus vulgaris), peas (Pisum sp.), peanuts (Arachis hypogaea) and soybeans (Glycine max), which are important in agriculturally-developed countries, the majority of food legumes are of importance only to the peoples of the developing countries. Preliminary attention is proposed for only six species, grouped according to the following ecological regions of adaptation:

A. Low humid tropics - pigeon peas (Cajanus cajan) and cowpeas (Vigna sinensis).
B. Semidry or seasonal tropics - peanuts (Arachis hypogaea).
C. Tropical intermediate elevations to temperate zones - soybeans (Glycine max)

and beans (Phaseolus vulgaris).

D. Cool weather, high elevation zone - chick-peas (Cicer arietinum).

Assignment of different species to specific regional laboratories is proposed, with attention to the following priorities:

1. Complete collection and evaluation of the world germ plasm for each species.
2. Research on increasing yield and improving quality by breeding, taking into account protein quantity and quality, and reduction or elimination of antimetabolites, toxins and flatulence factors, as well as improving consumer acceptance characteristics (flavor, cooking quality). Resistance to plant diseases, insect susceptibility and similar qualities must also be improved.

A USDA group (22) believes there are a number of important ways in which beans can be improved nutritionally through breeding:

a) Increase essential amino acids now limiting;
b) increase total protein to more than 30%;
c) reduce or eliminate toxin content; and
d) improve digestibility, including elimination of flatulence factors.

These studies are concentrating on:

1. Screening many varieties for high total protein.
2. Study of environmental variables influencing total protein and methionine content.
3. Hybridization studies to determine inheritance of protein content.
4. Comprehensive study of protein distribution in various seed tissues.

Another USDA legume group (23) believes that it is more important to increase total protein than to correct amino acid imbalance, although both factors need study. They found after screening 350 lines of Phaseolus vulgaris that protein content varied from 19% to 31%.

The group at Makerere University involved in pigeon pea (Cajanus cajan) studies proposes the following list of problems as of primary concern (24):

1. Nutritional interrelationship among sulfur-bearing amino acids, i. e. the compensatory role of methionine and cystine.
2. Need for rapid methods of screening large numbers of samples for all the relevant essential amino acids (in legumes: methionine, cystine, tryptophan, threonine). Relationships to total sulfur should be established.
3. Better and more convenient bioassay methods for protein. Test species (micro-organisms, insects, small mammals) should have few stringent environmental requirements and good adaptation to tropical regions.
4. More information on effect of antimetabolites such as trypsin inhibitor, hemagglutinins, etc., on protein availability in animals, and the variability of such factors in legume species.
5. Rapid antimetabolite screening methods for analyzing large numbers of breeding samples, and evaluation of interference by antimetabolites in bioassay procedures for protein and amino acids.
6. Screening methods for flatulence factor in legumes. To what extent is this factor genetically controlled? How does it vary among genotypes of a common species?
7. Physiological mechanisms for accumulation and translocation of antimetabolites and related undesirable factors during plant and seed development.
8. Better processing methods, hopefully useful at the village level, for reducing or eliminating antimetabolites, flatulence factor, toxic principles and undesirable flavors.
9. Need for efficient centralized assay services available to plant breeders.

Good progress is being made at Makerere with pigeon pea improvement due to this species' comparative freedom from disease, great range of genetic diversity and some tendency to cross-pollinate.

In another study (25), 3,000 varieties, lines and selections have been screened for methionine using a microbiological assay. Efforts will be made to breed for low flatulence and antimetabolite levels since these factors may inhibit efficient nutrient utilization as much as or more than amino acid imbalance.

For optimal nutritional availability, legume protein appears to need about triple the normal level of sulfur amino acids and twice the normal content of tryptophan to equal animal protein.

The poor digestibility of legume constituents requires the attention of breeders. Legume protein may vary in digestibility from 65% to 90% which means that in some varieties over 25% of the protein consumed may pass through the intestinal tract without being absorbed. The low availability of carbohydrate fractions, for example in soybeans, also appears to need research attention.

The cooking quality of legumes similarly leaves much to be desired, some species requiring 3 to 4 hours to cook properly with ordinary boiling. Others are adequately prepared in half this time. As pointed out by the Rockefeller group (21), little if any selection or breeding attention seems to have been given to this most critical and important of consumer acceptance factors.

Efforts are under way in India to breed Lathyrus sativus of lower toxin content. From parental lines with a mean neurotoxin content of 0.375g/100g of seed, Indian workers obtained lines in the M_3 generation with 0.117g/100g of seed (26).

Other crops

Progress is being made in improving protein quantity and quality in triticale, oats, millet, yams, and sweet potatoes. Similar studies with potatoes have been initiated. Interest has developed recently in improving the protein content of cassava (manihot) which is a major starchy food staple of humid tropical zones of Africa and the Americas. The discovery in Colombia of varieties having a protein content of 6% or more may forecast important breeding developments.

Problems and developments in analytical methods

Caution must be exercised in interpreting crude protein levels since Kjeldahl nitrogen may include nonprotein nitrogen, which compromises relationships to nutritive value (27). Decreased protein or amino acid availability may be related to metabolically resistant polysaccharides or polyphenols. Tannins are known to be active binders of protein.

Although the micro-Kjeldahl technique continues as a standard method for total protein, dye-binding methods are being used increasingly (28). A pyridine colorimetric procedure for lysine is now recommended for maize, wheat, rice and triticale (3), and a papain-digestion colorimetric method for tryptophan is now practical (3).

Microbiological determination of methionine with Streptococcus zymogenes is recommended (29). Another microbiological method for methionine and cystine uses Leuconostoc mesenteroides (30).

A microbiological technique for screening legumes for flatulence is available, which depends on the gas-producing characteristics of Clostridium perfringens, the principal intestinal anaerobe which may be the primary source of flatus gases (31).

Hemagglutinating activity in soybean protein can be determined photometrically, while its antitryptic activity can be measured using a synthetic substrate for more reproducible results (32). For more rapid biological testing of nutritive value, a group at Michigan State University claims to have successfully standardized a bioassay using the meadow vole (Microtus pennsylvanicus) which requires only 5 grams of diet containing 7% of protein per day (33). On the other hand, a Nebraska group (34) believes the mouse to be an excellent species for biological assay, combining low ration requirement, well-known nutritional needs, and availability of consistently uniform inbred animals from commercial sources. Another University of Nebraska group has developed a modified chick assay method for PER suitable for screening new crop lines (35).

Danish workers have found that there is an inverse relation between the blood urea content of test animals and the biological value of the diet which is sufficiently accurate (coefficient of variation - 53%) to provide a useful method for the prediction of protein quality (36).

Factors such as processing quality and food functionality need to be better defined in terms amenable to quantitative measurement and easy application to large numbers of samples in breeding programs. A screening sequence has been developed for rice at the Indian Agricultural Research Institute (37) which incorporates agronomic characters, protein quantity and quality, starch characteristics, physicochemical aspects of protein bodies, and biological value (see Figure 1).

With appropriate modification and introduction of other analytical techniques, such a sequence should be applicable to all grains and legumes.

Conclusions

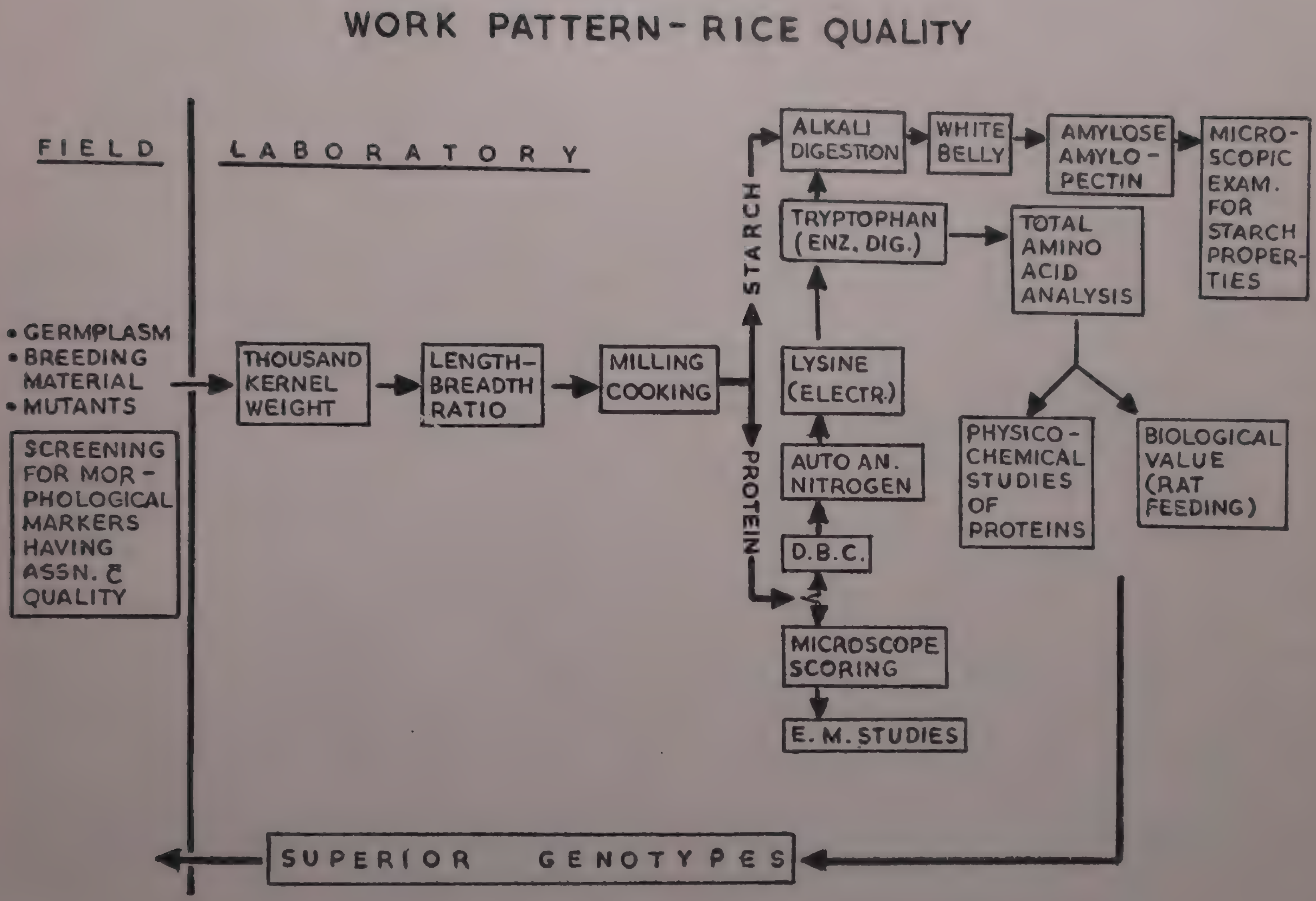
This review suggests that despite the wide scientific interest and good progress being achieved in research related to the nutritional improvement of major food crops, particularly in protein quantity and quality, there may exist serious gaps in the total effort. It would appear that an international expert group such as an *ad hoc* working group of the PAG might serve a useful function in this field at least in the following ways:

1. Propose research efforts needed to improve various food crops.
2. Identify and recommend needed research to develop and test analytical and biological screening methods, and propose priorities for such work.
3. Recommend research needed to quantitate factors related to food processing and consumer acceptance.
4. Encourage and facilitate international exchange of scientific and technical information and of appropriate genetic material.
5. Maintain effective liaison, as appropriate, with the Technical Advisory Committee of the FAO/UNDP/IBRD Consultative Group on International Agricultural Research, the International Development Research Centre (Canada), various regional institutes (CIMMYT, CIAT, IRRI, etc.) and other international and national crop research centers.
6. Develop on a continuing basis, or as necessary, nutritional and food quality guidelines for plant breeders, to be published by PAG.

References

1. Protein Advisory Group. 1970. Plant improvement by genetic means. PAG Statement No. 8. United Nations, New York 10017, U. S. A.
2. IAEA/FAO. 1970. Improving plant protein by nuclear techniques. Proceedings of a Symposium, Vienna, 8-12 June.
3. US/AID. 1971. Assaying improved high protein crop cultivars for developing countries. Report of Workshop, Washington, D. C., Office of Agriculture and Fisheries, Technical Assistance Bureau. Washington, D. C., U.S.A., May 6-7.
4. US/AID. 1971. Improving the nutrient quality of cereals. Report of a Workshop on Breeding and Fortification. Washington, D. C., U. S. A.
5. American Chemical Society, Division of Agricultural and Food Chemistry. 1971. Symposium on Seed Proteins: Synthesis, Properties and Processing. Los Angeles, California, U.S.A., 29 March to 2 April.
6. American Association of Cereal Chemists. 1971. Biochemical genetics in cereals. Dallas, Texas, U.S.A., 10-14 October.
7. Milner, M. 1970. Processing and food acceptance aspects of plant breeding. Document 1. 16/3, 17th PAG Meeting. (a somewhat revised version was published in reference 2).
8. Private communication from Dr. Ricardo Bressani, 19 May 1971.

FIGURE I


WORK PATTERN- RICE QUALITY
FIELD
LABORATORY
• GERMPLASM
• BREEDING MATERIAL
• MUTANTS
SCREENING FOR MORPHOLOGICAL MARKERS HAVING ASSN. C̄ QUALITY
THOUSAND KERNEL WEIGHT
LENGTH-BREADTH RATIO
MILLING COOKING
STARCH
PROTEIN
ALKALI DIGESTION
WHITE BELLY
AMYLOSE AMYLO-PECTIN
MICROSCOPIC EXAM. FOR STARCH PROPERTIES
TRYPTOPHAN (ENZ. DIG.)
TOTAL AMINO ACID ANALYSIS
LYSINE (ELECTR.)
AUTO AN. NITROGEN
D.B.C.
MICROSCOPE SCORING
E. M. STUDIES
PHYSICO-CHEMICAL STUDIES OF PROTEINS
BIOLOGICAL VALUE (RAT FEEDING)
SUPERIOR GENOTYPES

9. Private communication from Professor O. E. Nelson, April 29, 1971.

10. Nelson, O. E., and E. T. Mertz. 1971. Nutritive value of *floury-2* maize. Submitted for publication in Science.

11. Harpsted, D. D. 1971. High lysine corn. Sci. Am. 225: 34-47.

12. Linares, F. A., A. G. Pradilla and C. A. Francis. 1971. Protein quality of flint phenotypes of *opaque-2* modified maize. Western Hemisphere Nutrition Congress, Miami Beach, Florida, U.S.A., 30 August - 2 September.

13. Purdue University. 1970. Sorghum protein project committee review. Report to Agency for International Development.

14. Private communications from Dr. V. A. Johnson (July 8, 1971) and Mr. Paul J. Mattern (June 7, 1971).

15. Denic, M., and J. Dumanovic. 1971. Improvement of cereal grain protein quantity and quality through induced mutation. Fourth United Nations Conference on Peaceful Uses of Atomic Energy, Geneva, Switzerland.

16. Private communication from Dr. B. O. Juliano, April 28, 1971.

17. Adair, C. R., and B. D. Webb. 1971. Breeding high protein rice, oats and barley varieties. Presented at AID Workshop (see reference 3 above).

18. Private communication and IAEA reports

of Dr. S. Tanaka, July, August, 1971.
19. Hagberg, A., K. E. Karlsson and L. Munck. 1970. Reference 2, pp. 121-132.
20. Doll, H. 1970. IAEA Study Group Meeting on Induced Mutations and Plant Improvement, Buenos Aires, Argentina.
21. Roberts, L. M. 1970. The food legumes; recommendations for expansion and acceleration of research.
22. Silbernagel, M. J. 1971. Bean protein improvement work by USDA. Report of The Tenth Dry Bean Research Conference, ARS 74-56, Agricultural Research Service, USDA.
23. Rutger, J. N. 1971. Variation in protein content and its relation to other characters in beans (Phaseolus vulgaris L.). Report of the Tenth Dry Bean Research Conference, ARS 74-56, Agricultural Research Service, USDA.
24. Private communication from Dr. K. O. Rachie, May 4, 1971.
25. Report by Dr. J. F. Kelly (see reference 3 above).
26. Swaminathan, M. S., M. S. Naik, A. K. Kaul and A. Austin. 1970. Reference 2, pp. 165-182.
27. Private communication from Dr. R. P. A. Sims, July 7, 1971.
28. Villegas, E. and E. T. Mertz. 1971. Chemical methods currently used at CIMMYT for screening maize populations for protein quality. Paper presented to AID Workshop (see reference 3 above).
29. Kelly, J. F., A. Firman and H. L. Adams. 1971. Microbiological methods for estimation of methionine content of beans. Paper presented to AID Workshop (see reference 3 above).
30. Report by M. W. Adams (see reference 3 above).
31. Rockland, L. B. 1969. The search for a convenient assay method for the flatulence factor in dry beans. Report of the Ninth Dry Bean Conference, ARS 74-50, Agricultural Research Service, USDA.
32. Liener, I. E., et al. 1955. Arch. Biochem. Biophys. 54: 223-231; 1969. Cereal Chem. 46:518-26.
33. US/AID. 1971. The meadow vole (Microtus pennsylvanicus) as a bioassay of cereal protein quality. Report presented to AID Workshop (see reference 3 above).
34. Kies, C., 1971. Biological assay of cereals. Report presented to AID Workshop (see reference 3 above).
35. Sullivan, T. W. 1971. Bioassay of high protein crops with chicks. Report presented to AID Workshop (see reference 3 above).
36. Eggum, B. 1970. J. Nutr. 24: 983-8.
37. Swaminathan, M. S., and A. K. Kaul. 1971. From lecture given at IAEA/SIDA Training Course, July.

THE USE OF EMULSIFIERS FOR PRODUCING PROTEIN - FORTIFIED BREAD*

by Professors C. C. Tsen and W. J. Hoover, Department of Grain Science and Industry, Kansas State University, Manhattan, Kansas, U. S. A.

Protein malnutrition, a serious problem for people whose diets consist mainly of cereal or starchy products, has aroused interest in fortifying commonly-consumed foods with protein. Because bread is a staple in many countries, it is an ideal food to fortify with protein.

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Of all protein-rich additives now available, soy flour is the most attractive in price and quality. Soy flour (defatted) is a valuable additive for bread, not only because of soy flour's high protein, but also for its 3.2 per cent to 3.8 per cent lysine (1). For example, adding 12 parts soy flour to 100 parts wheat flour could increase total protein content about 30 per cent, depending on the protein content of the wheat flour used. Lysine is the first-limiting amino acid in wheat flour (2). The lysine content of such fortified bread would be about twice that of white (wheat) bread. Thus, the soy-fortified bread can greatly improve human diets nutritionally.

Although fortifying wheat flour with protein-rich additives offers an effective way to combat protein malnutrition, the fortifiers, such as soy flour, can induce adverse effects on dough properties and bread quality (3-8). Improvements in the quality of commercial, defatted and processed soy flour for baking and modifications in breadmaking by increasing bromate and reducing the fermentation period all have alleviated adverse effects of soy flour fortification (4-8). Changes in formulation or mixing time, or both, were examined by Matthews, Sharpe and Clark for making breads containing 25 per cent oilseed flours (9). Although they found that the soft-dough method gave a larger loaf of fortified bread than the straight-dough method, their loaf volumes were far below acceptable standards.

Pomeranz, Shogren, and Finney in 1969 found that adding natural (wheat or *Briza spicata*) and synthetic glycolipids or sucroesters to wheat flour permitted adding up to 16 per cent soy flour and other protein-rich foodstuffs to bread formulas without a significant loss in physical qualities (10, 11). However, natural glycolipids are uneconomical and approval of sucroesters has not been requested of the US Food and Drug Administration.

Our studies since 1968 on actions of various food emulsifiers, such as sodium stearyl fumarate, calcium stearoyl-2-lactylate (CSL), sodium stearoyl-2-lactylate (SSL), propylene glycerol monostearate, monoglycerides, polyoxyethylene sorbitan monooleate (Tween 60), and succinated monoglycerides in relation to dough strengthening effects show that SSL and CSL can form a complex with gluten to stabilize the gluten network in dough (12, 13). The dough strengthening effect also suggested that SSL and CSL could improve the baking performance of wheat flour fortified with high levels of soy flour or other protein-rich additives. Accordingly, a series of studies were undertaken to examine the improving effects of emulsifiers, particularly SSL, for making high-protein or protein-fortified breads. The keeping quality and nutritive value of such breads were also evaluated. Results of those studies have been reported in detail (14-17), and only the highlights are presented here.

Conditions for making high-protein breads with SSL

Unless otherwise stated, the wheat flour used in our tests was a blend of hard red spring and hard red winter wheat flour milled by a commercial mill and the soy flour was a typical commercial, defatted and chemically-treated product. Defatted cottonseed flour, fish protein concentrate, and nonfat dry milk (NFDM) were commercial products. Chickpea flour was ground by a laboratory mill. Characteristics of the ingredients are given in Table I.

TABLE I. INGREDIENT CHARACTERISTICS

Ingredient	Moisture, %	Protein, %*	Ash, %	Crude lipid, %
Wheat flour	11.4	11.8	0.46	-
Soy flour	6.8	52.6	6.80	-
Nonfat dry milk	6.4	34.9	8.0	-
Fish protein concentrate	4.8	80.0	13.7	0.1
Cottonseed flour	7.0	60.3	7.6	0.7
Chickpea flour	6.7	20.3	2.6	5.6

*Protein content is %N x 6.25, except x 5.7 for wheat flour.

To establish optimum processing conditions for making high-protein breads by our modified sponge-dough method (14), three basic responses were evaluated; mixing, absorption and oxidation.

Mixing response. Dough mixing is critical in determining quality of bread containing 12 per cent soy flour and 0.5 per cent SSL. Optimum mixing time for the soy dough was 2.5 minutes compared with 5.5 minutes for control dough. That is, the mixing requirement is only 45 per cent as long when 12 per cent soy flour is incorporated.

Absorption response. Flour absorption changes when it is fortified with 12 per cent soy flour. Results of our tests showed that optimum absorption of fortified flour ranged from 77 to 79 per cent, an increase of 11 to 13 per cent from the 66 per cent of control flour. Thus about 1 per cent extra water is required for each 1 per cent soy flour added to dough.

Oxidation response. Many deleterious effects of soy flour, as a bread supplement, can be overcome by raising the bromate level, as several workers have observed. We added various levels of bromate (in addition to 0.25 per cent bromate-type yeast food used in the sponge formula) to the dough formula to test bromate response. Twenty ppm bromate was optimum to oxidize the flour fortified with 12 per cent soy flour. As 0.25 per cent of yeast food adequately matured the control flour, it could be estimated that optimum bromate would be approximately 1.7 ppm for each 1 per cent fortified soy flour used. Too much or too little bromate lowers the baking quality of bread containing 12 per cent soy flour and 0.5 per cent SSL.

Improving effects of emulsifiers (SSL, CSL, and ethoxulated monoglycerides (EM))for making high-protein breads

Under the above optimum conditions, we examined effects of different levels of SSL on the baking performance of fortified flour, with corresponding tests on control flour under its optimum processing conditions (14).

Because calcium stearoyl-2-lactylate (CSL) differs from sodium stearoyl-2-lactylate (SSL) only in the salt form, we conducted a similar set of tests using CSL instead of SSL. Results of these tests (Table II) showed that:

a) SSL is more effective than CSL. SSL's superiority was evident in loaves made from the control flour and became more pronounced for leaves made from the fortified flour. "Specific loaf volume" is an important parameter of bread's marketability. In the United States, specific volume of marketable bread should be at least 6.00 with acceptable appearance, crumb texture, and grain. As shown in Table II, a marketable bread containing 12 per cent soy flour can be made by adding 0.5 per cent SSL but not by adding 0.5 per cent CSL.

b) CSL and SSL can improve overall dough-handling properties during mixing and molding.

Our recent studies show that ethoxylated monoglycerides, like SSL or CSL, also effectively improve the baking performance of wheat flour fortified with various protein-rich additives (17).

TABLE II. EFFECT OF INDICATED TREATMENTS OF SSL OR CSL ON SPECIFIC VOLUMES OF LOAVES MADE FROM WHEAT FLOUR SUPPLEMENTED WITH 12% SOY FLOUR

Agent	Amount added, %	Average loaf volume, cc	Average specific loaf volume, cc/g	Loaf score*	
				I	E
Control	0	2443	5.38	3	4
SSL	0.25	2556	5.63	6	7
SSL	0.50	2835	6.25	7	8
SSL	1.00	2833	6.24	7	7
CSL	0.25	2479	5.46	6	4
CSL	0.50	2561	5.69	7	5
CSL	1.00	2615	5.76	7	6

*Loaf score for external (E) and internal (I) characteristics 18 hours after baking. Finished bread is regarded as unsatisfactory if the score is less than 5.

Effect of different soy flours

Baking performance varies with different wheat flours; to make high-protein breads, the baking quality of various soy flours should be evaluated in addition to that of wheat flours. Defatted and full-fat soy flours are available commercially. From our comparative baking tests with both kinds of soy flour using the Kansas State Process (a no-time dough process), we found from the data listed in Tables III and IV that all breads with 12 to 28 per cent soy flour, defatted or full-fat, had small loaf volumes and poor grain scores. When 0.5 per cent SSL or EM was added, acceptable breads resulted from wheat flour fortified with defatted soy flour up to 12 per cent or with full-fat soy flour up to 24 per cent (17), so the baking quality of full-fat soy flour is superior to that of defatted soy flour. Whether protein quality, fat, and natural emulsifiers (such as glycolipids and lecithin in full-fat soy flour) are responsible for this superiority remains unknown.

TABLE III. EFFECTS ON BAKING QUALITY OF FORTIFYING WHEAT FLOUR WITH INDICATED PERCENTAGES OF FULL-FAT SOY FLOUR

Soy flour, %	SSL, %	Absorption, %	Bromate, ppm	Mix, min.	Av. loaf vol., cc	Av. sp. loaf vol., cc/g	Grain score
12	0	76	70	5.0	2223	4.90	4
16	0	80	70	4.0	2077	4.58	4
20	0	84	70	3.5	1923	4.24	3
24	0	88	70	3.5	1733	3.82	2
28	0	92	70	3.0	1461	3.22	2
12	0.5	76	70	5.0	3003	6.62	9
16	0.5	80	70	4.0	2876	6.34	8
20	0.5	84	70	3.5	2830	6.24	8
24	0.5	88	70	3.5	2735	6.03	7
28	0.5	92	70	3.0	2640	5.82	7

TABLE IV. EFFECTS ON BAKING QUALITY OF FORTIFYING WHEAT FLOUR WITH INDICATED PERCENTAGES OF DEFATTED SOY FLOUR*

Defatted soy flour, %	SSL, %	Average loaf volume, cc	Average specific loaf volume, cc/g	Grain score
12	0	2059	4.54	4
16	0	1878	4.14	3
20	0	1542	3.40	2
24	0	1438	3.17	2
28	0	1334	2.94	2
12	0.5	2821	6.22	8
16	0.5	2613	5.76	7
20	0.5	2291	5.05	6
24	0.5	1928	4.25	5
28	0.5	1533	3.38	3

* Breadmaking conditions the same as in Table III.

In many poverty areas where diets are deficient in both protein and calories, full-fat soy flour can become an ideal supplement because of its high protein and fat content. Furthermore, facilities for producing full-fat soy flour can easily be set up at much less expense than for defatted soy flour. This should enhance the usefulness of full-fat soy flour for making high-protein bread in poverty areas where both protein and calories are needed most.

Fortifying flour with various protein-rich foodstuffs

Table V summarizes baking results obtained from flour fortified with various protein-rich additives and treated with SSL or CSL. SSL or CSL obviously improve the baking performance of all the fortified flours but SSL is more effective than CSL for other additives, as it is with soy flour.

Each protein-rich additive was added so that its protein contribution was equivalent to that of 12 per cent soy flour. All except chickpea flour produced acceptable bread with a specific volume above 6.00; apparently we used too much chickpea flour (31g/100g wheat flour). If it could be further purified to raise its protein content, probably no difficulty would be encountered using it to fortify wheat flour.

We used many other protein-rich foodstuffs, such as single cell protein and casein products, to fortify wheat flour. All made acceptable breads when SSL or CSL was added (14).

TABLE V. SPECIFIC VOLUMES OF LOAVES PREPARED FROM FLOUR SUPPLEMENTED WITH INDICATED PROTEIN CONCENTRATES AND TREATED WITH SSL OR CSL

		Specific loaf volume, cc/g			
Agent	Amount added, %	Nonfat dry milk	Fish protein concentrate	Cotton-seed flour	Chick-pea flour
Control	0.0	5.12	4.48	5.23	4.55
	0.25	5.36	5.67	5.55	4.74
SSL	0.50	6.32	5.99	5.70	5.01
	1.00	6.39	-	6.11	5.15
	0.25	5.58	4.99	5.25	4.66
CSL	0.50	5.51	5.14	5.27	4.77
	1.00	5.79	5.24	5.35	5.15

Staleness evaluation

For staleness evaluation, breads were made from wheat flour fortified with 20 per cent full-fat soy flour with or without 0.5 per cent SSL. Control breads with no soy fortification also were prepared with the same processing conditions by the Kansas State Process.

Table VI shows average compressimeter (Bloom gelometer) readings in grams for loaves stored 1, 3, and 5 days. Soy bread without SSL staled rapidly; its crumb became so firm that all compressimeter readings registered more than 500g. SSL effectively helped stored breads (soy and control) retain softness; soy bread with 0.5 per cent SSL compared favorably with the control bread with 0.5 per cent SSL and exceeded the control bread without SSL in softness retention. No soy bread showed any sign of off-flavor after five day's storage (17).

TABLE VI. AVERAGE COMPRESSIMETER READINGS (g) OF STORED CONTROL BREADS AND BREADS CONTAINING 20% FULL-FAT SOY FLOUR

Bread	Days stored		
	1	3	5
Control	101.2	140.1	181.3
Control + 0.5% SSL	68.1	93.8	115.8
Soy	346.6	437.6	>500.0
Soy + 0.5% SSL	76.7	85.1	134.0

Shortening-sparing effect of SSL and CSL

Most commercial bakers in the United States add 3 per cent shortening, generally texturated lard, to produce plain white bread. Shortening is not normally added to white bread in most European countries. Shortening can influence dough mixing, handling, proofing and bread volume; and it imparts desirable eating and keeping properties to the finished bread. Of those functions, the most important is to increase loaf volume substantially.

Adding SSL at 0.25 per cent or CSL at 0.50 per cent to a sponge formula could spare or replace shortening (texturated lard) normally required in plain white bread or bread containing 12 per cent soy flour. SSL was more effective than CSL in replacing shortening. In producing high-protein bread, 0.50 per cent SSL replaced all shortening and gave an acceptable loaf superior to that with 3 per cent shortening in volume and grain score. With SSL or CSL limited to 0.25 per cent and shortening to 1 or 2 per cent, a complementary action appeared between SSL or CSL and shortening, reflected by better volume than with SSL, CSL or shortening alone, as shown in Table VII (15).

TABLE VII. EFFECTS OF SSL, CSL, AND SHORTENING AND COMBINATIONS OF THEM ON QUALITY OF BREAD CONTAINING 12% SOY FLOUR

SSL, %	CSL, %	Shortening, %	Average specific loaf volume, cc/g	Loaf score I	Loaf score E
0	0	0	5.38	3	4
0.25	0	0	5.63	6	7
0.25	0	1.0	6.34	6	7
0.25	0	2.0	6.25	7	6
0.50	0	0	6.25	7	8
0.50	0	1.0	6.22	7	8
0.50	0	2.0	6.26	8	6
0	0.25	0	5.69	7	5
0	0.25	1.0	5.68	6	6
0	0.25	2.0	6.09	8	7
0	0.50	0	5.69	7	5
0	0.50	1.0	5.91	7	7
0	0.50	2.0	6.12	7	8
0	0	3.0	5.75	5	8

It should be emphasized here that the shortening-sparing action of SSL, together with the higher absorption from soy fortification, can substantially lower production costs of high-protein bread. The estimated cost for producing such enriched breads with 12 per cent soy flour is almost the same as for producing white breads in the United States and Japan.

The Kansas State (no-time dough) Process for making high-protein breads

A simple method for making high-protein breads should increase their use in improving man's diet. With a simple method, bakers without much knowledge or experience in breadmaking could easily produce acceptable high-protein breads in poverty areas of the United States or developing countries where such breads are needed most.

In an effort to simplify present methods for making high-protein breads, we found that no-time dough gave large loaf volume of soy bread with better grain score than did the 40- and 75-minute fermented doughs baked by a straight-dough method (16).

No-time dough also exhibited excellent molding properties. Dough fermented for 75 minutes had torn surfaces after proofing, so that the crust of the finished bread wrinkled.

SSL could further improve baking performance of no-time dough containing 12 per cent soy flour. Soy bread made with SSL, added at 0.5 per cent, had an acceptable volume, excellent grain and appearance, and good break and shred compared with control bread and shortening-treated bread. The no-time dough process for making soy bread did not require a specially designed high-speed mixer (as does the Chorleywood process (18)) or use cystine (as does the Reddisponge process (19)) because soy flour reduces both mixing and fermentation requirements. This no-time process, referred to simply as the "Kansas State Process" could be used advantageously to make high-protein breads, particularly for United States schools and institutions and in developing areas. It saves labor and time, and it is a simple process to follow (16).

Nutritional feeding studies with high-protein bread

Shamsuddin (20) has used rats to evaluate the nutritive value of high-protein breads. Male, Charles River 22-day-old albino rats were fed three diets using a completely randomized design, 8 replications per diet. The rats ranged from 50-54 grams at the beginning of the test.

As shown in Table VIII, the enriched bread formula using 12 per cent soy flour significantly increased weight gains above gains from enriched white bread or enriched bread containing 3 per cent nonfat dry milk solids (NFDM). Rats fed high-protein breads ate more than those fed the other breads.

Protein efficiency ratios indicate rats on high-protein bread used protein efficiently. Feed consumption and body weight gain data also indicate that rats on high-protein breads were more efficient in feed conversion, which agrees with the data by Guggenheim et al. (21). They reported higher nutritive value of bread containing soy flour than that of commercial white bread as measured by growth of rats.

TABLE VIII. AVERAGE WEIGHT GAIN, FEED CONSUMPTION, PROTEIN EFFICIENCY AND FEED CONVERSION BY RATS FED BREAD DIETS

Diet	Gain,[a] g	Feed consumed,[b] g	Protein efficiency[c]	Feed conversion[d]
Vitamin and mineral enriched white flour	13.6	191.3	0.51	14.0
Vitamin and mineral enriched white flour + 12% soy flour + 0.5% SSL	101.7	384.6	1.56	3.5
Vitamin and mineral enriched flour + 3% nonfat dry milk solids	17.6	171.0	0.66	9.7

[a] Average gain per rat 0-4 weeks, LSD (0.01)

[b] Grams of feed consumed 0-4 weeks, LSD (0.01)

[c] Grams gain per gram of protein consumed, LSD (0.01)

[d] Feed conversion grams feed/gram weight gain

Summary

Bread is an ideal food to fortify with protein because it is a staple food in many countries, but fortifiers such as soy flour can induce adverse effects on dough properties and bread quality. However, we have used three food emulsifiers, sodium stearoyl-2-lactylate (SSL), calcium stearoyl-2-lactylate (CSL), or ethoxylated monoglycerides (EM), to effectively improve baking performance of wheat flour fortified with soy flour or other protein-rich additives, with no adverse effects. Accordingly, acceptable high-protein bread containing a high level of soy flour or other protein-rich additives such as cottonseed flour and fish protein concentrate can be made by adding one of these three food emulsifiers.

Full-fat soy flour can become an ideal supplement in many poverty areas, where diets are deficient in both protein and calories, because of its high protein and fat content. Its baking quality is also superior to that of defatted soy flour.

SSL helps stored breads (soy and control) retain softness (to extend the shelflife of breads).

SSL or CSL, added to a sponge formula at 0.25 and 0.50 per cent, respectively, can replace shortening (texturated lard) normally required in white bread or high-protein bread. Savings on shortening can offset, at least in part, the cost of the emulsifier.

The Kansas State (no-time dough) Process has been developed to make acceptable high-protein breads. It is a simplified process with a great time-saving advantage, and it could be used in expanding production of high-protein breads in poverty areas or for the school lunch program in the United States and in developing countries where such breads are needed most.

The nutritional benefits of high-protein breads have been demonstrated in studies using the breads in diets of experimental rats.

References

1. Department of Grain Science and Industry, Kansas State University. Summary of AID samples. Unpublished data.

2. Kies, C., and H. M. Fox. 1970. Determining

of the first-limiting amino acid of wheat and triticale grain for humans. Cereal Chem. 47: 615.

3. Pollock, J. M., and W. F. Geddes. 1960. Soy flour as a white bread ingredient. I. Preparation of raw and heat-treated soy flours and their effects on dough and bread. Cereal Chem. 37: 19.

4. Bohn, R. T., and H. H. Favor. 1945. Functional properties of soya flour as a bread ingredient. Cereal Chem. 22: 296.

5. Finney, K. F. 1946. Loaf volume potentialities, buffering capacity and other baking properties of soy flour in blends with spring wheat flour. Cereal Chem. 23: 96.

6. Bayfield, E. G., and E. C. Swanson. 1946. Effect of yeast, bromate and fermentation on bread containing soy flour. Cereal Chem. 23: 104.

7. Ofelt, C. W., A. K. Smith and R. E. Derges. 1954. Baking behavior and oxidation requirements of soy flour. I. Commercial full-fat soy flours. Cereal Chem. 31: 15.

8. Ofelt, C. W., A. K. Smith and J. M. Mills. 1954. Baking behavior and oxidation requirements of soy flour. II. Commercial defatted soy flours. Cereal Chem. 31: 23.

9. Matthews, R. H., E. J. Sharpe and W. M. Clark. 1970. The use of some oilseed flours in bread. Cereal Chem. 47: 181.

10. Pomeranz, Y., M. D. Shogren and K. F. Finney. 1969. Improving breadmaking properties with glycolipids. I. Improving soy products with sucroesters. Cereal Chem. 46: 503.

11. Pomeranz, Y., M. D. Shogren and K. F. Finney. 1969. Improving breadmaking properties with glycolipids. II. Improving various protein-enriched products. Cereal Chem. 46: 512.

12. Tsen, C. C. 1969. The action of surfactants on flour protein in relation to their dough-strengthening effect. Proceedings of the Annual Meeting of the American Bakers Association Technical Liaison Committee with the United States Department of Agriculture. October 8, Albany, Calif., U.S.A.

13. Tsen, C. C. 1970. Action of surfactants on flour protein in relation to their dough-strengthening effect. Report of the 55th Annual Meeting of the American Association of Cereal Chemists. October 18, Minneapolis, Minn., U.S.A.

14. Tsen, C. C., W. J. Hoover and D. Phillips. 1971. The use of sodium stearoyl-2-lactylate and calcium stearoyl-2-lactylate for producing high-protein breads. Baker's Digest 45 (2): 20, 74.

15. Tsen, C. C., and W. J. Hoover. 1971. The shortening-sparing effect of sodium stearoyl-2-lactylate and calcium stearoyl-2-lactylate in bread baking. Baker's Digest 45 (3):38.

16. Tsen, C. C., and R. T. Tang. 1972. Process for making high-protein breads. I. Soy bread. Baker's Digest (in press).

17. Tsen, C. C., and W. J. Hoover. 1972. High-protein bread from wheat flour fortified with full-fat soy flour. Cereal Chem. (in press).

18. Chamberlain, N., T. H. Collins and G. A. H. Elton. 1961. Chorleywood bread process. British Baking Industries Research Assoc. Report No. 59.

19. Henika, R. G., and S. F. Zenner. 1960. Baking with the new instant development process. Baker's Digest 34: 36.

20. Shamsuddin, M. 1972. Evaluation of breads containing protein supplements and sodium stearoyl-2-lactylate or sucrose tallowate. Ph. D. Dissertation, Kansas State University, Manhattan, Kansas, U.S.A.

21. Guggenheim, K., E. Perez, J. Ilan,

S. Joseph and A. Goldberg. 1962. The nutritive value of proteins of human diets as affected by extraction rate of flour. Am. J. Clin. Nutr. 10: 231.

San Juan, Puerto Rico

SEMINAR ON NUTRITION AND AGRICULTURE IN THE CARIBBEAN

A comprehensive three-day symposium under this title was held in San Juan, Puerto Rico, from 28-31 May 1972 under the sponsorship of the Latin American Nutrition Society, and the Medical Sciences Departments of the University of Puerto Rico and the Puerto Rico North-South Center. Nutritionists, public health specialists, agriculturists, extension education personnel and food scientists representing many of the governments of the Caribbean area and international agencies (FAO, WHO/PAHO and PAG) participated.

The primary objective was to explore areas of common concern and cooperative action between agricultural policy makers in governments and the nutrition and public health specialists and thus to emphasize the need for closer collaboration between these groups in advising governments in agricultural, food and nutrition policy.

Presentations in an opening session dealt with nutrition status in the Caribbean, the related organization of agriculture, and future planning in food production. Reviews from Puerto Rico, Haiti, Guatemala, Colombia, Jamaica, Virgin Islands, Trinidad and Tobago and Venezuela were presented.

The availability of various food resources in relation to agricultural practices, and the role of food technology and the food industry as well as of certain international organizations were explored in another session.

In a third session the role of education and extension in agriculture, including consumer education, and the support needed for supplementary feeding programs were examined.

A major discussion dealt with formulation of a national nutrition and agriculture policy in which various facets of this question were presented. In the final session priorities for various components of national policies were discussed and a resolution to inform the governments of the region on the conclusions and recommendations of the meeting was drafted. This will be circulated shortly to governments and a publication of the symposium presentations and discussion will also appear.

Guatemala City, Guatemala

MEJORAMIENTO NUTRICIONAL DEL MAIZ

El Instituto de Nutrición de Centro América y Panamá (INCAP) llevó a cabo del 6 al 8 de Marzo de 1972 en su sede, una conferencia a nivel internacional, sobre el Mejoramiento Nutricional del Maíz. En esta reunión, auspiciada por la Agencia Internacional del Desarrollo (AID), contó con la participación de 27 conferencistas de Colombia, Venezuela,

Perú, Brasil, México, Ghana, Nigeria, Estados Unidos y Guatemala, quienes cubrieron temas de interés común para estos países consumidores de maíz.

La conferencia, dividida en seis sesiones, fue enfocada hacia cuatro puntos esenciales:
a) valor nutritivo del maíz común y del opaco-2;
b) producción de maíz común y del opaco-2;
c) industrialización, mercadeo y consumo del maíz en la América Latina y
d) fortificación del maíz.

Habiendo invitado a expertos de cada país de los anteriormente mencionados, la conferencia resultó exitosa no solo por las aportaciones y recomendaciones obtenidas, sino por las conclusiones de sumo interés para estos países cuya alimentación básica es el maíz, y por lo tanto tan urgidos de mejorar nutricionalmente este cereal.

Además de los conferencistas, se contó con la asistencia de personeros de agencias nacionales e internacionales y representantes de la industria, interesados en los diferentes aspectos de la conferencia. Las memorias, conteniendo los trabajos presentados, serán publicadas en inglés y en español, y estarán disponibles en el INCAP, apartado postal 1188, Guatemala, Guatemala, a partir del mes de Septiembre de 1972.

Paracas, Peru

DESSARROLLO DE POLITICAS NUTRICIONALES INTEGRALES

Resumen del seminario realizado en Paracas, Peru, durante la semana del 5 al 9 de Julio de 1971.

En estos últimos años se ha venido desarrollando entre los nutricionistas del concenso de que la solución a los problemas nutricionales de la población sería necesariamente de caracter multidisciplinario. Vale decir, que los diversos sectores que influyen en la cadena de abastecimiento de alimentos y el consumo de estos por el hombre, tienen que ser abordados simultanea y coordinadamente.

Este seminario fue realizado precisamente con el propósito de extender este concepto entre representantes de las diversas disciplinas asociadas a la nutrición, así como de recoger conceptos adicionales, mediante la interacción de nuevas opiniones y diferentes puntos de vista.

Con este propósito se reunieron 32 especialistas representando las siguientes áreas o profesiones: Ecología y Recursos Naturales, Agricultura, Pesquería, Tecnología, Economía, Antropología, Sociología, Medicina, Educación, Planificación, Evaluación y Nutrición, Ciencias Políticas y Administrativas.

El seminario se realizó de acuerdo a la siguiente mecánica:
Durante el día los participantes presentaron individualmente sus trabajos, en los cuales se reflejaban nuevos conceptos de sus respectivas especialidades. Por la noches los participantes se distribuyeron en grupos o comités de integración para analizar las presentaciones del día y extraer conclusiones y recomendaciones de acuerdo a los siguientes criterios:

I. Orientación al Público
II. Política de Alimentos y Nutrición
III. Investigación Científica y Técnica
IV. Orientación a la Industria de Alimentos

La totalidad de las conclusiones que no se incluirán aquí por razones de espacio, pueden obtenerse de la Secretaría de la

Sociedad Latinoamericana de Nutrición. Sin embargo, y a manera de resumen de estas conclusiones los participantes de este seminario en reunión plenaria emitieron la siguiente declaración:

1. Que el problema de alimentación y nutrición en Latinoamerica constituye un lastre muy serio, para el bienestar y desarrollo de la región, perpetuando una dramática situación de inequidad social en los grupos mayoritarios de la población.
2. Que es indispensable aunar esfuerzos y recursos pluri-institucionales -nacionales e internacionales- y multi-disciplinarios para hacer frente a esta situación deficitaria de alimentación y nutrición.
3. Que los científicos y técnicos deben mantener una participación dinámica y activa en la solución de los problemas más urgentes de alimentación y nutrición, mediante la aplicación de medidas prácticas y viables, basadas en aquellos conocimientos científicos actualmente disponibles.
4. Que la Sociedad Latinoamericana de Nutrición (SLAN), actúe como valioso elemento catalizador en la formulación e implementación de las políticas nacionales de alimentación y nutrición, que se está promoviendo con gran entusiasmo por los Gobiernos Latinoamericanos con la colaboración de la OPS, OMS, FAO, UNICEF, UNCESCO y CEPAL.
5. Que se establezcan a nivel nacional, regional y local, mecanismos y sistemas estructurales de coordinación que permitan articular efectivamente los esfuerzos y recursos científicos, económicos y técnicos, para el desarrollo de las políticas de alimentación y nutrición.
6. Que en la formulación e implementación de políticas de alimentación y nutrición se dé la indispensable participación al público productor y consumidor, sujeto y objeto de la problemática nutricional.

QUICK - COOKING LEGUMES*

Edible seeds of the Leguminosae family have been cultivated for food throughout the world for more than 80 centuries. In many areas, legumes containing 2.5 to 4.5 per cent nitrogen are still principal sources of food protein. In urbanized, developed countries, legumes have become secondary protein foods, the animal sources being utilized more extensively at a large cost differential. Regressing utilization of dry beans for food has been attributed to: 1) inconvenience due to prolonged preparation and cooking; 2) lower protein quality associated with less than optimal proportions of methionine; and 3) gastrointestinal distress, bloat and flatulence experienced after ingesting legume products. In some areas of the world, extended cooking requirements impose upon fuel cost and availability. Fermented products, prepared from bean flour or hydrated ground beans which cook more quickly, provide a measure of fuel economy in some of the developing countries.

A simple, convenient process has been developed for the preparation of various types of quick-cooking products from legumes including large lima (Phaseolus lunatus), small white, pink, pinto, kidney and other common beans (Phaseolus vulgaris), blackeye beans (Vigna sinensis) and chickpeas or garbanzo beans (Cicer arietinum). Processed beans cook within 15 minutes (even at higher altitudes), effecting an 80 to 90 per cent reduction in the normal cooking time. They have a smooth, uniform texture, enhanced natural flavor, and excellent color and general appearance. No significant differences in composition have been detected between the processed, quick-cooking legumes and corresponding products prepared by conventiona

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* Material submitted by the Western Regional Research Laboratory, U.S. Dept. of Agriculture, Berkeley, Calif. Further details and references may be obtained from Dr. L. B. Rockland of that laboratory.

soaking and cooking procedures. Nutritional properties of the bean proteins, estimated by protein efficiency studies with rats, were not affected by processing. Human and microbiological assays indicated that quick-cooking large lima beans had about 50 per cent less flatulence activity than beans prepared in the usual manner.

The process consists of: 1) loosening seed coats by intermittent vacuum infiltration (Hydravac process used for large lima beans) or blanching (common beans) with either steam or hot water and 2) soaking the beans in a solution of several common inorganic salts including sodium chloride, sodium tripolyphosphate, sodium bicarbonate and sodium carbonate. Minor variations in the composition and ratios of salts, processing time and temperature are used to optimize the process for individual varieties.

The raw, processed, quick-cooking beans can be utilized in a variety of ways. They may be cooked immediately after processing and used as boiled beans; blended with meat and cheese as casserole dishes suitable for institutional, military and school lunch feeding programs; or used in frozen and canned food products. Frozen, quick-cooking beans require only 10 to 15 minutes to soften and develop their unique texture, natural flavor and maximum nutritional value. Frozen beans have been stored for up to two years without observable changes in quality. Redried quick-cooking beans require about 30 minutes to tenderize without presoaking. The dry beans have been stored for more than six months at ambient temperatures without significant changes in color, flavor, texture, appearance or cooking time. Raw processed beans may also be cooled and maintained at normal refrigerator temperature (40°F, 4°C) for up to 8 weeks without spoilage. In contrast, rehydrated legumes prepared in the conventional manner sour and spoil within 24 to 48 hours. Dry legumes may be stored conveniently at ambient temperatures for extended periods and shipped at minimum rates. Processing can be performed on demand, independent of harvest time or origin during slack or off-season periods, using conventional processing equipment normally available in frozen food and other food processing plants.

Because of their short cooking time, processed beans can be cooked on a continuous basis by pumping them through a relatively short length of steam-jacketed pipe or other continuous, low-pressure cooker. The cooked beans can be utilized in a variety of commercial products such as canned or frozen salads and soups, or used in the preparation of legume powders. The powders may find applications in the preparation of refried beans, bean paste, soup mixes, instant bean dip or as high-protein supplements for bakery products, cereals and snack foods.

A FEASIBILITY STUDY OF OPAQUE - 2 MAIZE*

The objectives of a study carried out by CIAT were to identify obstacles to successful expansion of production, marketing and human consumption of opaque-2 maize and to suggest ways by which these obstacles may be overcome.

It was found that a rapid expansion of the production and consumption of opaque-2 maize was limited by 1) low consumer acceptance; 2) wholesalers' lack of interest in handling the product; 3) low relative farm yield in comparison with high-yielding hybrids; 4) low producer acceptance among small farmers and 5) storage problems. These problems directly relate to the floury and soft endosperm of opaque-2 maize as compared to the commonly grown flint-type maize. The softness of opaque-2 also results in low resistance to insect attacks, low kernel density and undesirable appearance and cooking characteristics.

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*Annual Report, 1970, Centro Internacional de Agricultura Tropical (CIAT), Cali, Colombia.

Results suggest that success in introducing and expanding commercial production for human consumption of the present varieties of *opaque-2* could only be solved by a considerable subsidy by the government to farmers in conjunction with promotional campaigns among producers, marketing agencies and consumers. However, if a flint-type, high-lysine maize with a high yield capacity could be developed, government support could be reduced or even eliminated.

In spite of field production and marketing problems, a cooperative ICA[*]-CIAT project is under way to promote the adoption of the present commercial *opaque-2* hybrids among small farmers in Colombia and to stimulate industrial utilization in an effort to improve nutritional levels among urban populations.

The plan includes:
- institutional coordination and integration of the various agencies working in the agricultural sector of Colombia.
- long-range cooperative projects among research extension and public health institutions.
- organization of short courses, seminars, conferences and symposia to communicate the objectives of the program to technical personnel.
- use of all possible forms of media to inform the public about the purposes of the program and the importance of *opaque-2* maize hybrids.
- planting of 40 tons of *opaque-2* seed on 2400 hectares of land with an expected total yield of 4800 tons.

NUTRITIVE VALUE OF THE WINGED BEAN[**]

Although it has been known that the winged bean (*Psophocarpus palustris* Desv.) has a protein and fat content similar to that of soybeans, it has not received much attention as a possible source of vegetable protein for supplementary feeding of children. This bean has now been grown successfully for several seasons at the Agricultural Research Station of the University of Ghana, which is situated in the forest area at Kade. Earlier attempts to grow soybeans in this area have been unsuccessful.

While the winged bean is botanically different from the soybean, the composition of the dry seeds is similar: 37.3 per cent protein, 18.1 per cent fat, 13.9 ppm thiamine, and 1.8 ppm riboflavin. The oil of the seeds contains 125.9 mg tocopherol ($\gamma + \beta$)/100 g. The amino acid composition of the protein is also similar to that of soy protein. Methionine is the first-limiting amino acid. The content of unsaturated fatty acids and of polyunsaturated essential fatty acids is satisfactory. Active trypsin inhibitor found in the raw seeds was destroyed by applying direct steam in an autoclave for 10 minutes at 130° or by boiling beans which had been soaked in water for 10 hours, for 30 minutes. No urease activity was detected.

In rats, the PER (protein efficiency ratio) and NPU (net protein utilization) were superior to those of groundnuts. As a supplement (2 parts winged bean) to maize flour (3 parts) adjusted to 10 per cent or 16 per cent protein, the PER values were similar to that of skim milk. Even in the raw state, the winged bean has a pleasant, sweet taste. (K. Cermý *et al*. 1971. Brit. J. Nutr. 26: 293-299.)

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[*] Instituto Colombiano Agropecuario

[**] From Nutrition Newsletter No. 28, Jan. 3, 1972, Sidney M. Cantor Associates, Inc.

FOOD AND AGRICULTURE ORGANIZATION AGRICULTURAL SERVICES BULLETINS AVAILABLE

1. Technology of the production of cottonseed flour for use in protein foods. Bulletin No. 7; AGS: ASB/71/1. 42pp.
2. Technology of production of edible flours and protein products from groundnuts. Bulletin No. 10; AGS:ASB/10. 88 pp.
3. Technology of production of edible flours and protein products from soybean. Bulletin No. 11; AGS:ASB/11. 151 pp.

These publications are available from: Agricultural Services Division, FAO, Via delle Terme di Caracalla, 00100, Rome, Italy.
or
The Protein Advisory Group of the United Nations System, United Nations, N.Y. 10017, U.S.A.

V. N. Patwardhan and W. J. Darby:

THE STATE OF NUTRITION IN THE ARAB MIDDLE EAST

This book provides a critical review of the food and nutrition situation in the six Arab countries, Libya, Egypt, Lebanon, Syria, Jordan and Iraq. Following an introductory chapter on the land, the people and conditions of their life, there are 14 chapters which examine and evaluate all available data on food supplies, dietary practices, nutritional problems and current research and developmental activities in the region. Although the information is presented separately for each country in the region, which is inevitable due to lack of adequate information from some of the countries, the authors have been able to project an integrated nutritional picture for the whole region without failing to point out the differences between countries and the reasons for such differences. Areas for further research are identified and suitable programs based on available knowledge are suggested for the amelioration of malnutrition.

Patwardhan, V. N., and W. J. Darby. 1972. The state of nutrition in the Arab Middle East. Vanderbilt University Press, Nashville, Tenn., U.S.A. 308 pp. US$15.00.

RECENT PUBLICATIONS

Ciba Foundation/Nestlé Foundation. 1972. Lipids, malnutrition and the developing brain. Proceedings of a Joint Symposium held in London, 19-21 October 1971. Associated Scientific Publishers, Amsterdam, Holland and New York. 326 pp.

Eskin, N. A. M., H. M. Henderson and R. J. Townsend. 1971. Biochemistry of foods. Academic Press, New York and London. 240 pp.

McLaren, D. S., and N. J. Daghir. 1971. Proceedings of the 6th Symposium on Nutrition and Health in the Middle East, April 26-29. American University of Beirut, Lebanon. 416 pp.[*]

Mosher, A. T. 1971. To create a modern agriculture. Agricultural Development Council, Inc., New York, N. Y., U. S. A. 162 pp. paperbound.

Smith, A. K., and S. J. Circle (eds.). 1972. Soybeans: chemistry and technology. Volume I: Proteins. Avi Publishing, Westport, Conn., U. S. A. 470 pp.

Taylor, C. M., and K. P. Riddle (eds.). 1971. International bibliography of nutrition education. Teachers College Press, Columbia University, New York. 192 pp, paperbound.

Thio Goan Loo. 1971. Small-scale processing of soybeans and some applications. Department of Agricultural Research of the Royal Tropical Institute, Amsterdam, Holland. Publication No. 294. 29 pp, paperbound.

White, P. L., and N. Selvey. 1972. Proceedings of Western Hemisphere Nutrition Congress III, Miami Beach, Florida, U. S. A., August 30 - September 2, 1971. Futura Publishing Co., Mount Kisco, N. Y., U. S. A. 389 pp.

PAG STATEMENTS AVAILABLE

No.	Title	Date
2	PAG Recommendation on aflatoxin	1969
3	PAG Statement on the nature and magnitude of the protein problem	1971
4	PAG Statement on single cell protein	1970
5	PAG Statement on the marketing and distribution of protein-rich foods	1971
6	PAG Statement on milk substitutes	1970
7	PAG Recommendation on prevention of food losses and protein-calorie malnutrition	1969
8	PAG Statement on plant improvement by genetic means	1970
9	PAG Recommendation on amino acid fortification of foods	1970
10	PAG Statement on a systems approach to the formulation and evaluation of nutrition intervention programmes	1970
11	PAG Statement on leaf protein concentrate	1970
12	PAG Statement on the world protein problem: research and development needs	1971
13a	Review of the specific proposals contained in ACAST report "International Action to Avert the Impending Protein Crisis" United Nations, 1968	1971
14	PAG Statement on marketing of conventional foods	1971
15	PAG Statement on popular participation and community involvement in nutrition improvement programmes	1971
16	PAG Statement on the potential of fish protein concentrate for developing countries	1971
17	PAG Statement on low lactase activity and milk intake	1972
18	PAG Statement on relationship of pre- and postnatal malnutrition in children to mental development, learning and behavior	1972
19	PAG Statement on maintenance and improvement of nutritional quality of protein foods	1972
21	PAG Statement on specifications for solvents	1972

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[*] The meeting which gave rise to this Proceedings was reviewed in the PAG Bulletin No. 12, 1971. The present volume includes the contributions of the authors in full and these are presented as 51 separate articles, totaling 416 pages.

23	PAG Recommendations for the promotion of processed protein foods for vulnerable groups	1972

PAG GUIDELINES AVAILABLE

No.	Title	Date
2	PAG Guideline for preparing food-quality groundnut flour	1970
4	PAG Guideline for preparation of edible cottonseed protein concentrate	1970
5	PAG Guideline for edible, heat-processed soy grits and flour	1969
6	PAG Guideline for preclinical testing of novel sources of protein	1970
7	PAG Guideline for human testing of supplementary food mixtures	1970
8	PAG Guideline on protein-rich mixtures for use as weaning foods	1971
9	PAG Guideline on fish protein concentrate	1971
10	PAG Guideline on marketing of protein-rich foods in developing countries	1971
11	PAG Guideline for the sanitary production and use of dry protein foods	1972
12	PAG Guideline on the production of single cell protein for human consumption	1972
13	PAG Guideline for the preparation of milk substitutes of vegetable origin and toned milk containing vegetable protein	1972

PAG REPORTS AVAILABLE

1.	Feeding the preschool child: report of a PAG *ad hoc* working group	1971
2.	Manual on feeding infants and young children (Cameron and Hofvander)	1972

PAG Statements and Guidelines may be used and quoted freely. Copies may be obtained without charge from the Protein Advisory Group of the United Nations System, N. Y. 10017, U. S. A.

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PAG BULLETIN

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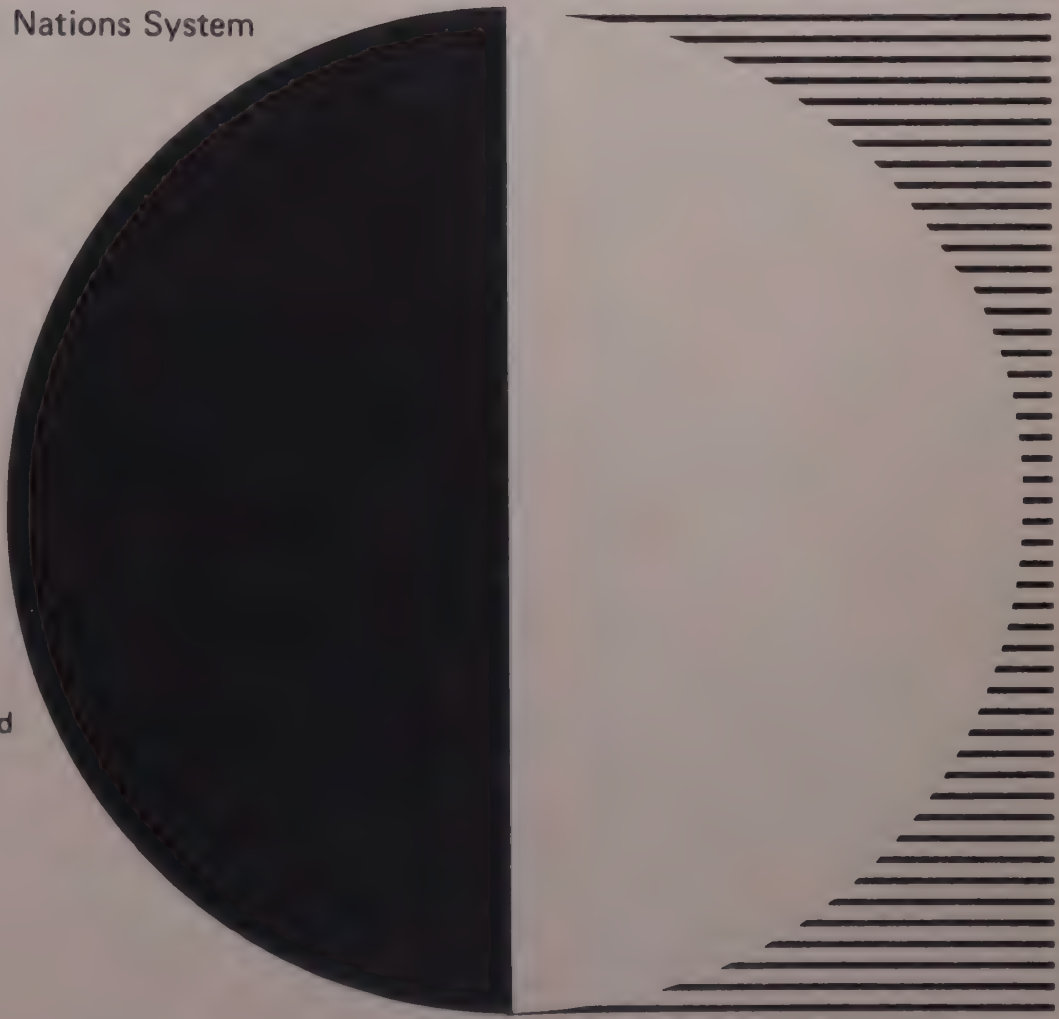

Food and Agriculture
Organization
of the United Nations
Rome

World Health Organization
Geneva

United Nations Childrens Fund
New York

International Bank
for Reconstruction and
Development
Washington

International review of action to improve world protein nutrition

THE PAG BULLETIN

Purpose

The PAG Bulletin is published by the Protein Advisory Group of the United Nations System. Its purpose is to give information on the world protein problem to those individuals, academic institutions and industrial organizations which are interested in helping solve the protein problem and to promote the exchange of information in this field.

Mailing list

The PAG Bulletin is sent without charge to persons, organizations, and companies with an active interest in proteins. The present mailing list comprises about 3900 names, approximately fifty per cent in the U. S. A. and the rest distributed throughout the world. Requests to be added to the mailing list for the PAG Bulletin should be addressed to the Director of Secretariat, Protein Advisory Group of the United Nations System, United Nations, N. Y. 10017, U. S. A.

Quotation

Permission to quote items from the PAG Bulletin is not required except from authors of signed articles. The Secretariat of the PAG would appreciate being informed of quotations made from the PAG Bulletin.

Suggestions

The PAG Bulletin will be successful only if it reflects all aspects of the protein problem comprehensively and objectively. The Secretariat invites suggestions and ideas for broadening and deepening the scope of the PAG Bulletin.

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TWENTIETH MEETING OF PAG, PARIS, JUNE 1972

The 20th Session of the PAG was held at Unesco Headquarters, Paris, 19-23 June 1972, under the Chairmanship of Professor N. S. Scrimshaw, with thirty-four participants. Representatives from the sponsoring agencies, FAO, WHO, UNICEF and IBRD took part in the meeting, together with representatives from IAEA (International Atomic Energy Agency), UNO/OST (Office of Science and Technology), UNDP (United Nations Development Programme), Unesco (United Nations Educational, Scientific and Cultural Organization), UNIDO (United Nations Industrial Development Organization) and WFP (World Food Programme). Four consultants joined in the deliberations on specific subjects. In memory of Dr. K.K.P.N. Rao, Senior Nutrition Advisor, FAO Regional Office in Bangkok, a minute of silence was observed at the opening meeting.

The Chairman introduced Mr. J.G. Fobes, Deputy Director-General of Unesco, and welcomed the following new members to the PAG: Dr. J. Cravioto, Dr. A. W. Holmes, Dr. H. Ruthenberg, Dr. S. Soemardjan, Dr. M. S. Swaminathan and Dr. K. Yamada. Mr. Fobes' opening remarks appear on page 4 of this Bulletin.

UN interagency and intergovernmental bodies discussion on protein

The PAG was briefed on the General Assembly discussion on protein and resolution 2848* titled "protein resources", the developments regarding sponsorship of PAG by UN agencies, PAG representation at agency governing bodies and the ACC review of PAG's annual report. It was noted with appreciation that the sixteen elements of action reviewed in the GA resolution were those drafted by the PAG at its 18th Meeting for use of the panel. Although the proposal regarding a protein fund was found to be interesting, it was noted that at present the source of funds has not been identified. The Group was informed of the participation of its representatives at the Governing Countil meeting of FAO, and Executive Board meetings of WHO and UNICEF. UNIDO sponsorship of PAG together with that of other UN groups (ESA, OST) is under consideration; the possibility of WFP making an annual subvention was also mentioned.

Proteins and calories

It was noted that there have been increasing expressions of opinion by those knowledgeable, that the UN is overemphasizing protein deficiency when the real problem is lack of balanced nutrition; articles have appeared suggesting that the protein question is being overemphasized at the expense of calorie needs. However, the Group urged that the importance of protein should continue to be emphasized for two reasons; firstly, the problem of uneven protein distribution leading to inadequate intake in certain regions of the world, areas of a country, among families and within families; and secondly, the inappropriateness of establishing policies and programs based on recommended allowances for healthy individuals of privileged populations consuming a mixed balanced diet.

While the name of PAG may suggest an oversimplification of the problem, the proposal to change its name to indicate the importance of deficiency of calories and other nutrients has not been found acceptable, mainly for administrative reasons. Though proteins are always of central importance, the PAG deals with protein needs only in the context of total dietary requirements. Protein foods may also be important sources of calories, minerals and vitamins. Availability of calories without excessive bulk is another important consideration for many children's diets.

The estimates of protein requirements are based on a factorial summation of various losses determined from highly-refined, short-term clinical studies with subjects free from all stress. There is bound to be a gap between requirements based on these considerations and those arrived at from epidemiological evidence of protein needs over long periods under practical living conditions.

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*This resolution was published in PAG Bulletin Vol. II, No. 2, 1972.

Strategies for establishing national supplementary feeding programs

This subject, discussed first at the 19th session, was taken up for reexamination at the 20th session. The Group considered the following issues specifically: program costs, continuity of availability of donated foods, the priorities of target groups, the extent of beneficial effects anticipated and obtained, and comparison of expenditure with alternative means of achieving the same goal. The difficulties of advance estimation of program costs were discussed and the absence of adequate systems to reach preschool age youngsters was noted. The emphasis on cost/benefit assessment was felt to be not always valid since if the program is directed toward the real target group where the problem of PCM is rife, the benefits will be obvious in reduced preschool child mortality and improved growth and development. It was considered impractical to attempt to include all preschoolers in any program, and in certain situations if only 10 to 30% could be covered, they should be from the most seriously affected groups. The dangers of adopting inadequate criteria for evaluation of nutritional benefits and the need for caution when interpreting the results of evaluation were stressed. No stand was taken on whether the recipient country should ultimately aim to undertake full responsibility for developing its own institutions and resources for the program initially launched and operated through donated food. Divergent opinions were expressed regarding the use of volunteers for operating such programs. Inadequate coordination at the national level, due to the multiplicity of agencies which contribute food aid to a single country, was seen as a real problem. Examination of the points of contact between feeding programs and family planning programs, so that the available resources could be pooled for attack on both problems, was suggested.

The PAG concluded that a working group, with the help of consultants, should examine the several questions posed during the discussion and prepare guidelines detailing how such feeding programs could be improved, with special emphasis on central planning, distribution mechanisms, institutional needs, types and methods of evaluation, etc.

The PAG restated the usefulness of fortifying skim milk powder with Vitamin A, noting that so far only shipments from the U. S. A. were so fortified.

Evaluation of the effectiveness of national and regional institutes of research and training in nutrition, food science and technology

It was noted that the report submitted by a consultant provided useful statistical information on a large number of institutes, indicating various problems and difficulties faced by these institutions. It was recommended that the PAG undertake case studies of the different types of institutes: successful ones, moderately successful ones and ones which are failures, so that the reasons for the disparity in performance could be pinpointed and recommendations formulated for steps to be taken to correct deficiencies.

Nutrition, family planning and fertility - evidence of their interaction and interrelationships

Fertility is used here in the demographic sense. The background document prepared by a consultant, which formed the basis for discussion, is reproduced in full on pages 8-16 of this Bulletin.

The health of mothers and their babies appears to be better if the latter are limited in number and there is a reasonable interval between pregnancies. The age of the mother seems also to influence the well-being of the child, as does the nutritional state of the mother. The issues before the meeting were: What is the evidence for all these beliefs and how might better evidence be obtained? The PAG had dealt with some aspects of this problem at the ad hoc working group meetings on feeding the pre-school child (PAG Document 1.14/5). The PAG, noting that these issues involve both medical and socioeconomic considerations, called for a review of these relationships, for analysis and classification of research which should be undertaken and for effective dissemination of the resulting information. The point was emphasized that family planning programs cannot be a substitute for supplemental feeding programs; today's children cannot be neglected but must be fed. The impact of family planning, hopefully within the decade, would reduce the number of children in need of supplementary feeding from resources outside the family.

The PAG felt that the discussion of this important relationship would help to stimulate action in appropriate quarters and recommended that WHO convene a working group which would bring nutrition and family planning personnel of WHO together, along with appropriate consultants, to develop a coordinated attack.

Current status of locally-produced, commercially-marketed, protein-rich weaning foods in developing countries

It was noted that the consumption of these products in relation to the dimension of the child malnutrition problem is small. Most bilateral and UN agencies devote a relatively minor proportion of their resources to nutrition and only a part of that to the establishment of facilities for local production of weaning foods. Private industry, with a few exceptions, is uninterested in risking capital for this type of enterprise. The project development cycle for this type of activity may be four to six years from the initial contact between government and agency until the project is marketing products commercially. The four points noted for special attention were: target groups' needs, consumer behavior and purchasing power; multiproduct development schemes; personnel and training requirements and marketing economics.

The early PAG efforts in this area were noted and it was proposed that PAG make strong recommendations to international agencies and countries to encourage projects for the production of protein-rich foods.

Secretary-General's Expert Panel recommendations on protein strategy - an analysis of research components and revision of PAG Statement No. 12

An exhaustive discussion on the priorities for research led to a proposal for the revision of PAG Statement No. 12. An attempt was made to indicate the overall world priorities in terms of the significance of the anticipated results of both short-term applicability and long-term significance. It was recognized that priorities will differ in relation to the needs of particular countries and regions. It was felt that there is a need to constantly examine the research priorities, identify research projects, their nature and objectives, the suitability of institutions, countries and the cost. It was recommended that the PAG members identify and draw up two or three model research projects for further discussion at the next session.

Unesco's interest in the PAG and related matters

In view of the location of the meeting at Unesco Headquarters this item was of particular interest. Senior members of the staff of Unesco from the education, natural sciences, social sciences, human sciences, culture and communications divisions participated. The Assistant Director-General for Sciences initiated the discussion by indicating several Unesco program activities with relevance to PAG interests and directed toward solutions of the malnutrition problem. In the field of social sciences, the several types of training programs available were described; these aim to produce a cadre of trained people. International study groups and workshops are promoted to bring together groups of scholars working in different disciplines for planning advanced research and training programs. The educational programs cover behavioral, social and cultural problems and also include development of educational policy. The activities of the agriculture and rural education sector are devoted to development of an integrated approach to education for rural development.

The communications sector is undertaking research to study basic phenomena affecting communication, its positive and negative aspects, and the types of media and their relative potentials. The application of mass media in long-term education, adult education and education of specific groups in the population were mentioned.

The important activity of the science policy division is to evaluate the effectiveness of education and the several factors which cause wastage and dropouts at the preprimary, primary and secondary levels.

The interest of Unesco in research on single cell protein was specifically mentioned and the training programs in molecular biology were briefly described.

It was noted that many points of the Unesco areas of activity are of great interest to PAG and important in the study, control and prevention of malnutrition. It was urged that the PAG receive Unesco inputs in all its activities and PAG in turn could provide its comments and suggestions to Unesco whenever desirable. The hope was expressed that Unesco would continue the mutually helpful close involvement in the work and objectives of the PAG.

Other items of discussion

The other items in the agenda considered by the PAG were revision of PAG Guideline No. 7 (human testing of supplementary foods), application of enzymes in the food industry, recent developments in coconut protein technology and leaf protein technology, and a summary of 1971-72 activities of the Technical Advisory Committee and the Consultative Group on International Agricultural Research.

ADDRESS BY MR. FOBES AT THE 20TH PAG MEETING

Although we may complain about some of the complexity and even the pretense of international machinery, yours is an activity we applaud. It is heartening to see the diversity of specialists and the several agencies here as witnesses to the importance of the protein problem. It is good when mankind shows awareness that its problems call for a multidisciplinary approach and for joint action in the fields of fundamental and applied scientific research, food production and distribution, education, the humanities and communications.

Unesco considers the steps taken by the United Nations and, in particular, the formation and activities of the PAG of importance. It can help us bind our forces together to understand somewhat better the relationship of the protein crisis to all of the other interlinked crises of today, and to initiate some survival actions. At a recent lecture at a university, I enjoyed citing the microbiologists working with Unesco and the PAG as evidence that there was innovative life in the UN system.

Here at Unesco, before your arrival, we had a little seminar to remind ourselves of your history, that the PAG originated from an advisory body set up by WHO to advise its Director-General on clinical nutrition problems; that in 1960 FAO and UNICEF joined the group, which then became more protein-oriented from 1964 onward. In 1969 Unesco became a participating member, and last year the IBRD joined the three sponsoring agencies.

Now there has been a logical broadening of the field of interest of the PAG, from proteins to protein-calories as a whole, as doubts have arisen that proteins alone can eliminate malnutrition. Finally, the initiative taken by the United Nations in 1971 to place more emphasis on the development of a global strategy to avert the protein crisis is complementing the excellent work done by the PAG on other levels.

I would like to recall that Unesco has been represented at your meetings since 1966 and has participated in several sessions of your ad hoc working group on single cell proteins. On Thursday afternoon, you are giving us an opportunity to speak of the increasing attention we are giving to the strengthening of those of our program activities which directly and indirectly can contribute to the solution of the protein-calorie problem. We will also speak of the constraints within which we operate and the points of view dictated by our other program concerns.

We recognize that, due to the important discoveries made in the last decade in the fields of fundamental research on carbohydrate and protein production (Green Revolution, single cell protein), the center of gravity of the protein problem is shifting from fundamental scientific research to problems of distribution and acceptability of new food products. Education must give the consumer the background to evaluate the biological value of his meals and enable him to select new food products which so far have not been part of his traditional diet.

Consequently, in the field of education, Unesco is strengthening its program in nutritional education. Special efforts will be made to develop strategies for nutrition and home/family education. In general, action will follow the Unesco policies for renovation of educational systems with emphasis on quality in education. Thus, nutrition and home/family education will be considered as component parts of all aspects of educational development - planning, curriculum development, educational materials and aids, evaluation and research.

For several years the Unesco program in agricultural education has included the training of educators and technicians at various levels in nutrition, food technology and food science, as well as the holding of regional meetings on problems of education and nutrition. A seminar for university teachers from Latin America is due to take place this year in Lima on "Education, Agriculture, Nutrition and Man", which is linked with the 1972 Conference of the Latinamerican Association of Nutritionists whose main theme will be "Exploring the Frontiers of Nutrition Education for the Masses". It is hoped that similar regional efforts in education can take place in other regions of the world.

Through the International Conferences on the Global Impacts of Applied Microbiology, Unesco, jointly with WHO, disseminates recent knowledge obtained in the field of protein production by microorganisms. Unesco/ICRO fellowships in applied microbiology are also aimed at the stimulation of research on potential protein resources in developing countries.

To focus attention on the protein-calorie problem and its consequences, Unesco published in March 1969 a special issue of the Unesco Courrier devoted to "The new food revolution" and this very month the Courrier reports on "Unesco's worldwide inquiry on school dropouts". It will interest you also to know that in 1970 the International Rice Research Institute in the Philippines and the International Maize and Wheat Improvement Center in Mexico shared the International Science Prize awarded by Unesco.

In the report, "Learning to be", to be published this summer by the prestigious International Commission on the Development of Education under Mr. Edgar Faure, attention is given to the effects of infant malnutrition in relation to learning capacity.

You will be interested to know that ECOSOC resolution 1640 (LI) and GA resolution 2848 (26th Session) were brought last week to the attention of our Executive Board which promptly put the problem of malnutrition among five subjects for special attention in our cooperation with other agencies.

The financial prospects for the coming biennium are not as bright as we had hoped. Moreover, there is a strong priority claim on funds for the implementation of major projects such as UNISIST[*], man and biosphere, population and oceanography.

Nevertheless, I can assure you that within the framework of the regular program, Unesco, in cooperation with you and other UN agencies, will endeavor to make an increasing contribution to activities designed to point out the protein-calorie problem, to enlarge public understanding of it, and to correct the situation.

PAG SYMPOSIUM ON NUTRITIONAL IMPROVEMENT OF FOOD LEGUMES BY BREEDING

This meeting was held at FAO in Rome from 3 to 5 July 1972. Sponsorship of the meeting was provided by the Rockefeller Foundation, British Overseas Development Administration, Swedish International Development Agency, International Development Research Centre (Canada), U.S. Agency for International Development and certain private organizations. Presentations and discussions were designed to identify information needed by the participants in order to draft recommendations for achieving the six objectives listed:

a) Higher protein levels and better amino acid profiles
b) Reduction of toxic constituents
c) Clarification of the need to eliminate flatulence factors
d) Development of improved processing and consumer acceptance properties
e) Compilation of useful screening methodology for measuring chemical, biochemical, nutritional and toxicological factors
f) Expansion of needed research efforts in these areas as well as those related to crop yield and productivity.

The symposium Chairman was Dr. L. M. Roberts of the Rockefeller Foundation, New York. Mr. J. F. Yriart, Assistant Director-General of FAO, welcomed the participants to FAO and endorsed the meeting's objectives. Dr. Roberts then presented the background and objectives of the meeting.

A keynote paper,"Legume research: a second-generation priority of the Green Revolution", was presented by Dr. N. Borlaug of the International Maize and Wheat Improvement Center (CIMMYT), Mexico. Dr. Borlaug believes that if an interdisciplinary team research approach with the legumes were undertaken immediately, based on the recent experience with cereal improvement, similarly successful results could be obtained in as little as 10 years.

The first agenda topic,"Nutritional importance of legumes in human diets",was chaired by Dr. M. Cépède, Institut National Agronomique Paris, France. A general review item was presented by Dr. R. Bressani of the Institute of Nutrition for Central America and Panama (INCAP), Guatemala, who analyzed the nutritional impact of legumes in diets of vario developing countries as used in combination with cereal staples, and the effects of toxic and other factors in legumes. Further amplification of this topic was provided by

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[*] United Nations International Scientific Information Services. " [T]o advance the trend toward information sharing by creating opportunities for further cooperative agreements among governments, international organizations and operating services".

Dr. Doris Calloway, University of California, Berkeley, U.S.A., Dr. I. E. Liener, University of Minnesota, St. Paul, U.S.A. and Dr. B. M. Nicol and Dr. P. Lunven, FAO, Rome.

The second agenda presentation,"Status and potential for genetic improvement of food legumes",was chaired by Dr. Borlaug. Developments in Southeast Asia, and particularly in India, were reviewed in a paper by Dr. M. S. Swaminathan, Indian Council of Agricultural Research, New Delhi (read by the PAG Scientific Secretary). Dr. M. Jalil of FAO presented the Latin American situation, and the status of legume improvement in Africa south of the Sahara was analyzed by Dr. K. O. Rachie of the International Institute of Tropical Agriculture, Ibadan, Nigeria. Discussants included Dr. J. F. Kelly, Campbell Institute for Agricultural Research, Cinnaminson, New Jersey, U.S.A.; Dr. E. Leng, University of Illinois, Urbana, U.S.A.; Mr. P. Oram, FAO, Rome; Dr. Alice Evans, University of Cambridge, England; Dr. P. Rubaihayo, Makerere University, Kampala, Uganda; Dr. S. Litzenberger, Agency for International Development, Washington, D.C., U.S.A.; Dr. M. W. Adams, Michigan State University, East Lansing, U.S.A. and Dr. D. Boulter, Durham University, Durham, England.

The third topic, "Nutritionally-related factors in legumes requiring genetic improvement", was presented under the chairmanship of Mr. J. H. Hulse, International Development Research Centre, Ottawa, Canada. Under this heading, the subject "Protein and amino acid profiles" was reviewed by Dr. Kelly and additional information was offered by Dr. K. J. Carpenter, University of Cambridge, Cambridge, England; Dr. V. Royes, University of West Indies, Kingston, Jamaica; Dr. L. Munck, Swedish Seed Association, Svalof; and Dr. B. Sigurbjornson, International Atomic Energy Agency, Vienna, Austria. A report on "Antitryptic and other toxic factors" was presented by Dr. Liener and the "Flatulence" problem in legumes was analyzed by Dr. Calloway. Further data were given by Dr. Munck, Dr. Leng and Dr. J. McGinnis, Washington State University, Pullman, U.S.A.

"Processing and food acceptance problems" were dealt with in a paper by Dr. H.A.B. Parpia, Central Food Technological Research Institute, Mysore, India (read by Dr. M. Narayana Rao, FAO), with further elaboration by Dr. Royes, Dr. G. Kapsiotis, FAO, Dr. Munck, Dr. Kelly, Dr. Carpenter and Dr. Liener.

The final agenda topic,"Analytical and mass screening techniques (chemical, biochemical, and toxicological)",was presented under the chairmanship of Dr. McGinnis. Dr. Carpenter reviewed "Methods available and others needed" and Dr. Evangelina Villegas of CIMMYT reported on "Useful experience from other food crops". Discussants included Dr. Leng; Dr. D. R. Wood, Colorado State University, Fort Collins, U.S.A.; Dr. Munck; Dr. McGinnis and Dr. R. Ferrando, École National Vétérinaire, Alfort, France.

Recommendations on all the problem areas including research needed were drawn up by drafting groups of participants. These will appear in the symposium publication together with the formal papers, discussants' comments and summaries of the general discussion. A PAG ad hoc working group under the chairmanship of Dr. Cépède (Vice-Chairman of PAG) met following the symposium and prepared a draft statement "Upgrading human nutrition through the improvement of food legumes".

NUTRITION, FAMILY PLANNING AND FERTILITY*

by Samuel M. Wishik, M. D.

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This presentation attempts to define the subject in broad scope, at least in outline. Breadth of coverage, therefore, is favored rather than what might be premature analysis in depth of any particular element. Even such a degree of breadth is itself carved out of a more expansive area by applying a restrictive definition to each of the three primary terms of the thesis.

Fertility (F) is used herein in the demographers' sense of the end result, the bearing of children, rather than the medical usage for the capacity of women to become pregnant. Of course, the end result is a composite of initial potential for conception and all ensuing influences up to giving birth and, with respect to survival, inclusive of subsequent factors as well. Also implicit in the definition of fertility is its usual reference to females. Recent interest in measurement of male fertility (1) opens the way to assessing the relationship to the nutritional state of men, who are not immune to the dietary restrictions and deleterious effects that accompany large family size.

Nutrition (N) is a component of health. This paper does not look at general health, whatever that is, or at other nonnutritional manifestations of health, but aims to encompass those evidences of subnormal or abnormal health status which nutritionists have elected to label as "nutritional". They have sometimes done this for known consequences of deficit of a specific nutrient, such as in anemia. But even this example illustrates a highly oversimplified concept; anemia is merely evidence of iron deficiency. Other symptoms or findings, such as skin-fold thickness, arm circumference, height/weight ratio, and now intellectual development, are considered signs of nutritional deficiency because clinical observations and sometimes laboratory studies suggest a causal or contributory relationship. The findings are clues to the cause and may be used to detect and measure the influence of that cause. We shall subscribe to this premise.

The term Family Planning (FP) is used here to denote services offered to individuals or programs directed at populations with the clear purpose of avoiding pregnancy or reducing F. We shall not be able, however, to avoid touching obliquely at certain more general efforts at societal betterment.

The subject will be approached by considering two pairs of relationships, each of which is two-directional:

I. $N \Longleftrightarrow F$
II. $N \Longleftrightarrow FP$

Ia. $N \longrightarrow F$

Nutritionists have long studied and have produced a rich literature on the effects of a woman's nutritional status on the likelihood of conception, course of pregnancy, chances of infant survival and growth and development of the child. Although gaps in knowledge exist concerning these four events and investigations must continue, certain generalizations are held by most authorities today:

1. Among populations of suboptimal nutritional status, short of outright starvation, gross interference with sperm production or conception probably does not occur (questions are now being raised about this).

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* Submitted as a background paper for the 20th PAG Meeting (PAG Document 1.29/1). Dr. Wishik is Director, Division for Program Development and Evaluation, International Institute for the Study of Human Reproduction.

2. Serious complications of pregnancy, delivery and puerperium can be attributed to nutritional aberrations of women during pregnancy (2) (there is a difference of opinion even about optimum protein content in the diet of pregnant women).

3. Among the offspring, congenital malformations, birth weight, constitutional strength, defenses against disease, growth and development and chance of survival may be modified by the mother's prenatal nutritional state.

The above and related considerations concerning the deleterious effects of maternal nutritional aberrations on pregnancy outcome are not new questions and are not the substance of the present paper. However, there are a number of other ways in which nutritional status and changes may have an impact on fertility.

A widely-recognized phenomenon is the secular trend to earlier menarche, which is attributed to improved standards of living, especially better nutrition. There is no convincing evidence, however, that earlier onset of menstruation is correlated with earlier exposure to pregnancy, younger age of women at their first birth or increase in achieved fertility during the totality of the child-bearing span. That there is no simple relationship is manifest in the average age of marriage of women rising in some countries while it falls in others. It is interesting that childbirth among women in their late teens is becoming progressively less hazardous in modernized countries (3, 4), perhaps because of better obstetrical care rather than for more general reasons. In less developed countries, the greater risk below 20 years of age persists (5). In any event, the importance of giving attention to the nutritional improvement of adolescent girls cannot be overemphasized.

Infant feeding practices also may affect fertility. It is generally accepted that lactation does delay the return of ovulation and menstruation after childbirth (6-9). The trend to bottle feeding in many areas not only threatens the infants but may shorten the intervals between births and nullify some of the efforts to reduce fertility.

Ib. N ← F

The focus of this paper is on the question "How do changes in F, the frequency, timing and circumstances of child bearing, affect the N of people and thereby their health and lives?"

Admittedly, the two-way relationships between N and F are difficult to separate from each other; in fact, they are interactive and cyclic. Herein lies one of the difficulties in delineating and measuring discrete effects. We shall attempt to summarize the state of knowledge and suggest directions for further investigation.

For this purpose, six parameters for F and two for N are submitted, although these will have to be reviewed more in combination than separately. For F:

1. the number of pregnancies and births women have;

2. the ages of women when they have the pregnancies and births;

3. the intervals which elapse between the episodes;

4. the practice of lactation;

5. the adequacy of medical care women receive to meet the needs of normal pregnancy, delivery and the postpartum period, to treat incidental complications thereof and to compensate for nutritional and other health deficits that the women bring to and endure during their maternal experiences; and

6. the general cultural and living context in which all the above take place.

It should be noted at this point that such listed F parameters are not viewed as being necessarily detrimental to nutritional status and health. Parous women may be less susceptible to breast cancer than nulliparous ones; pregnant women may feed themselves better because of their concern for the health of the unborn child; maternity care is the only contact many women in the world have with health services; and fruitful women are less threatened with divorce.

The selected parameters on N are of a nature different from those on F. They concern the two individuals, mother and child, who are most immediately affected by her fertility status:

1. during pregnancy and postpartum; and

2. at other times.

The impact of the mother's F on the nutritional status of the child takes place:

1. prenatally (embryological development, birth weight);

2. at the start of life (early enzyme capacity - immunities, metabolism); and

3. later (growth and development, diet, mother care).

Not all clinical impressions can as yet be documented statistically. Examples of study findings deserve mention, although without detailed discussion here on research design, sample selection and size, reliability of data collection, separation out of interrelated variables, etc. Women of higher parity are more prone to anemia (10) and to lower weight/height ratio (11). Children in larger families, especially with more preschool age children, or of higher birth order, suffer more from malnutrition (12, 13), grow more slowly (10, 14), are more anemic (10), have impaired mental development (14) and are offered diets that are poorer in calories and protein and that use less per capita expenditure (10, 14, 15).

Pregnancy is essentially a physiological stress and its occurrence is not without strain upon the woman's bodily resources. Repetition of the event should be expected to compound the strain unless full interim restoration to original status and capacity occurs. A rapid succession of pregnancies reduces the likelihood of full restoration, especially when additional stress and insults are imposed, such as the burden of lactation, marginal or subnormal prenatal health status, relative immaturity of the postadolescent years or cumulative premenopausal exhaustion.

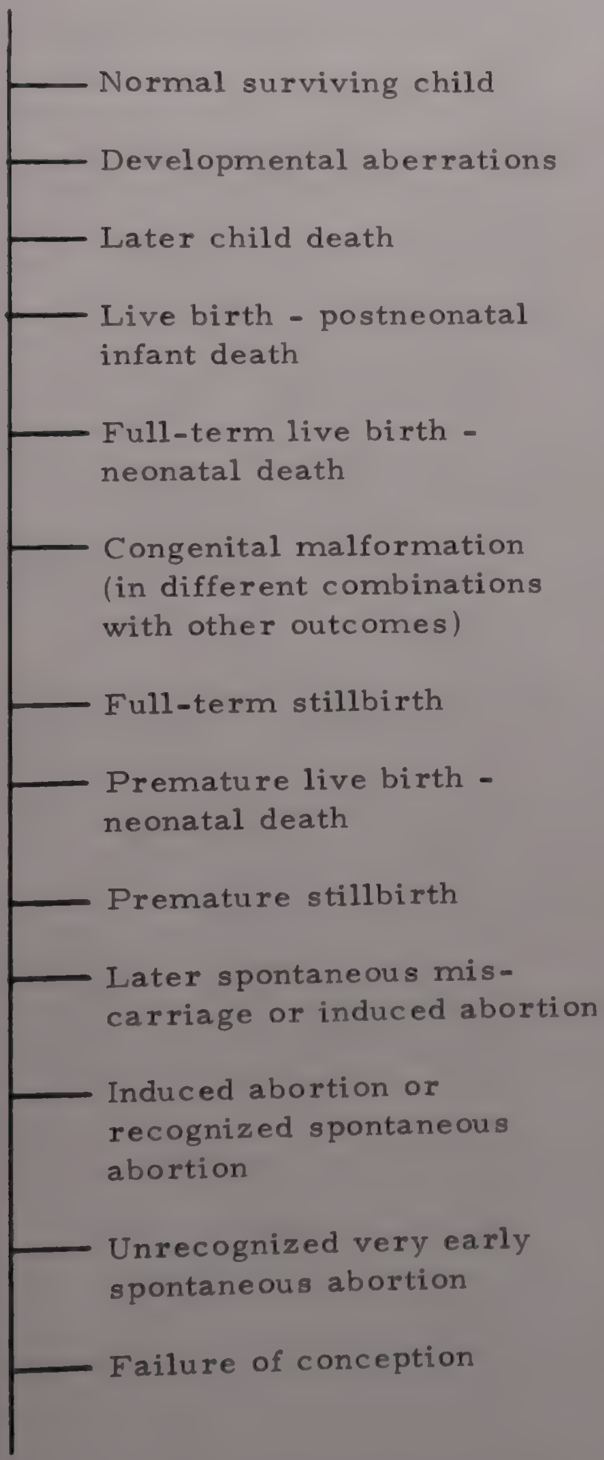
Hypotheses can be stated concerning the effects of two types of close birth spacing. A child whose birth follows closely upon that of a sibling may receive a poor start in life because of maternal drain (primarily physiologic factors). Children born at shorter intervals since the previous sibling birth grow more slowly (10) and are more often malnourished (14). A child whose birth is followed shortly by that of a sibling may be deprived of his due share of maternal care (socioeconomic deprivation) as well as being exposed to a shortened span of breast feeding (12, 14). Both hypotheses seem logical and reasonable; however it is not surprising that so little documentation exists on the effects of close birth spacing. It is extremely difficult to be certain that the intervals between births have actually been free of unreported interrupted pregnancies. Without this information, paradoxical findings could be obtained.

Additional research difficulties on the general question of the impact of F on N warrant mention. When the effects of uncontrolled fertility are appraised in terms of nutrition and when nutrition is narrowly defined, the most sinister outcomes - death and serious disease - are excluded by such definition. The persons worst hit die and escape the survey or display a syndrome deserving of a disease diagnosis or label other than malnutrition. This is an old story to nutritionists, who first called attention to the diarrhea/pneumonia mantle that disguises the importance of childhood malnutrition (16).

The visible portion of the iceberg metaphor is particularly apt for the subject of human reproduction. One could depict the possible outcomes of pregnancy as a hierarchy or stepladder, with each end result level removing or reducing the possibility of those on higher rungs (see Figure 1).

Again, a paradoxical phenomenon is possible

FIGURE 1. STEPLADDER OF FERTILITY OUTCOMES


Normal surviving child
Developmental aberrations
Later child death
Live birth - postneonatal infant death
Full-term live birth - neonatal death
Congenital malformation (in different combinations with other outcomes)
Full-term stillbirth
Premature live birth - neonatal death
Premature stillbirth
Later spontaneous miscarriage or induced abortion
Induced abortion or recognized spontaneous abortion
Unrecognized very early spontaneous abortion
Failure of conception

and must at times occur. For example, improvement in health care for a woman subject to repeated spontaneous pregnancy interruptions, perhaps not always recognized and usually not reported or counted, could extend the duration of gestation, not necessarily to full term but to premature labor and a neonatal death that would enter the visible realm of accountability and thereby worsen reported statistical rates. Of more specific interest to this subject are the aberrations of growth, development and nutritional status on the last rung before the top of the ladder, which should be studied together with as many of the lower steps as can be identified and measured.

II. N $\longleftrightarrow$ FP

This expresses the second bidirectional question of our thesis, "What are the relationships between nutrition and family planning?" These can be considered on an individual and a program basis on each side of the relationship (17, 18):

individual nutritional status	personal acceptance and practice of family planning
nutrition services	family planning services

IIa. N $\longrightarrow$ FP

When a woman feels well, she is better able to cope with discomforts associated with medical care, such as the side effects from contraception. Uterine bleeding is the most frequent reason for discontinuation of the intrauterine device. Prior anemia lessens a woman's tolerance to the additional blood loss. Similarly, it is possible that moderate malnutrition of a woman reduces her ability to handle the nausea that often occurs during the first months of use of oral contraceptives. Understandably, people are reluctant to be the first to accept a new practice, such as contraception, expecially when it runs counter to all previous beliefs and values and when it involves a clinical examination or procedure and calls for continued cooperation. The previous establishment of faith and confidence in the dispensers of the new teachings and treatment helps to allay suspicion and doubt (19). Nutrition workers of various categories often achieve strong rapport with their clients. This paper offers a fitting context in which to quip that the implications of intimacy and depth of affect associated with one's sexuality are probably exceeded only by one's protectiveness about food likes and preferences. Nutritionists can well believe that sex behavior may be easier to change than eating habits.

It is widely recognized that high infant mortality and the risk of child loss produce in families and populations an "insurance" philosophy - to have more children as a guarantee that some will survive. A rise in child survival is almost invariably a precursor of lowering of the birth rate. Opinions vary on the lag time between child mortality reduction, recognition that there are more children around and eventual change in fertility performance. Some say as long as 10 or 15 years or a generation (21), but others emphasize the significance of the actual number of older living children as an important determinant of continuing fertility behavior (22). The way seems clear - improve nutrition, lessen child loss and reduce fertility. It has even been stated that this is the only likely avenue of success (23). In any event, there is no denying the tremendous difference in personal suffering and social cost between the following two types of societies despite their having identical growth rates:

	A	B
Crude birth rate	30/1000	40/1000
Crude death rate	10/1000	20/1000
Growth rate	2%	2%

There are clear logistical as well as strategic reasons for integrating N and FP services and programs (24). The clients' needs are often concurrent - prenatal diet with preparation for contraception, postpartum contraception with correction of anemia, child feeding with family planning education, or advice against premature weaning with avoidance of closely spaced pregnancies. Obviously, the use of common facilities and personnel is a potentially advantageous administrative pattern. This may include agricultural extension workers, home economists or rural development workers or more specific health personnel who receive consultation and training from specialists in nutrition.

Administrative problems exist whenever integration of previously separate services is attempted and different solutions must be flexibly sought to fit different situations. Merging may be indicated at one or the other end of the center-to-periphery structure or somewhere between, depending on whether integration is desired for central direction, for field work or for the intermediate echelon of supervision (25).

Studies have been done (26), are continuing and others are projected (27) for estimating the magnitude of the task of launching and maintaining comprehensive Maternal and Child Health/Nutrition/Family Planning programs in less developed countries in terms of facilities, manpower and cost effectiveness. For the last feature, what is achieved by effort and expenditure should be evaluated with respect to the multiple objectives in health, nutrition and family planning and for this, authoritative input from each of the respective fields is needed.

Nutrition surveys antedated most other types of health surveys and the experience derived from them can contribute much to broader assessments of population health status. More specifically, in the course of sampling households or other population groups for nutrition studies, demographic information is obtained that is identical with some of the data collected when fertility surveys are made for evaluation of family planning programs. It seems reasonable to consider the possibility of doing a single survey for both purposes. At present, a study, is under way, under sponsorship of the Pan American Health Organization (28), to design a survey that may have three purposes: a) nutrition survey, b) fertility survey, and c) study of relationships between nutrition and fertility.

IIb. N ← FP

The perfect contraceptive has not yet been invented. The newer medical methods of contraception, especially steroids and intrauterine devices, constitute a great step forward, primarily because their use is dissociated from the sex act. Since, however, their mechanisms of action are upon functional or organ systems rather than mere mechanical barriers between ovum and sperm, there is a price in the form of adverse side effects, some of which have nutritional implications.

As stated before, the chief complaint about the intrauterine device (IUD) is the increased uterine bleeding that commonly occurs. The amount of blood loss is usually not gross enough to be of concern to a healthy woman. But since IUD's are often introduced not long after childbirth when most such women in less developed countries are anemic, the problem of anemia could be one of the chief determinants of the practicality of the mass use of IUD's in these countries. On an individual basis, health supervision of women wearing IUD's must include consideration of anemia.

It has been known for some time that regular steroid medication can have a mildly depressant effect upon liver functions, such as those related to fibrinogen, vitamin B6 and folic acid (29). Again, the question may be more momentous in less developed countries where some degree of hypofunction of the liver may exist as a common sequela of certain endemic diseases such as malaria, hepatitis and parasitosis. Studies are needed to clarify the matter.

Of greater concern is the known moderate suppression of breast milk production among lactating women. Once more, a matter of minor import in modernized societies looms larger in less developed countries where the very survival of young children depends on their mother's milk supply and where the nutritional state of the mother, too, is usually at a marginal or submarginal level. The Committee on International Nutrition Programs of the National Academy of Sciences is considering whether or not to accept a recommendation that has recently been submitted to it, the general tenor of which is to discourage use of estrogen-containing contraceptives during the early months of lactation. The rationale for such an approach is supported by the relatively low chance of pregnancy during that period. Whether the matter would be answered with full satisfaction by use of low-dosage progestagens awaits further study (30). An excellent summary of the subject has recently been presented (31). This summary calls attention to the complexities of research efforts to gain knowledge on the matter, including: the variety of products used, the range of dosage and time of use, selection of study sample and difficulty of obtaining continuity of observation, and problems of measurement of lactation by the woman's subjective impressions, volume and composition of collected milk, infant's weight, growth and development and other nutritional indicators.

Among other relevant unknowns warranting research is the extent of passage of contraceptive steroids through breast milk and the possibility of secondary effects upon the nursing infant. Assessment methods include observation of infant symptoms such as breast enlargement and vaginal bleeding and the possibility of isotope tracing.

The prostaglandins are too new a star on the family planning horizon to venture definitive opinions. Undoubtedly, the use of substances with such basic influences on smooth muscles and probably other tissues will open up new problems as well as directions of benefit that will have relevance to the field of nutrition.

The synergistic effect of FP programs in support of nutrition services deserves more than passing reference. Utilization of maternal health services (including nutrition components) rises when the desired FP is made available at the same time. The most striking and consistent example is the postpartum visit (e.g. 4-6 weeks), attendance at which is proverbially low everywhere and which doubles or trebles when family planning is also offered (32).

The postpartum visit could be one of the most strategic occasions for achieving health and nutritional improvement of mothers and children, as the "fourth phase" of modern maternity care. The first was competent attendance at childbirth, the second was prenatal care to forestall preventable complications and the third was the postpartum checkup to assess the return to normal pregravid health. Unfortunately, even for the small proportion of women who do make a postpartum visit, the service is usually at a time when the case is closed, since maternity has a self-limited time period. Instead, it should be the occasion for opening selected cases for ongoing interconceptional health supervision in view of the fact that, as maternal mortality decreases, serious morbidities in the mothers and disease and death among the children become increasingly concentrated in a relatively small group of "repeaters", those vulnerable to successive unfavorable pregnancy experiences and outcomes (33). Among disadvantaged population groups, the postpartum moment is the critical point for multipurpose intervention, including individual or group approaches for:

1. checkup on the woman's return to normal health and nutritional state and initiation of continuing education and correction of deficiencies;

2. checkup on the babies' health and initiation of guidance for their feeding and rearing; and

3. family planning to achieve desired birth spacing or family limitation.

These services are as essential for rural mothers and children as for hospital-oriented urban populations. The challenges are to identify basic services, to depart from traditional "standards" and to adapt to various levels of rurality, illiteracy and cultural conservatism.

Concluding statement

Implicit in the contents of this paper are indications for strengthening of services, research and training. This oversimplified presentation has omitted entirely considerations at the macro level, including such questions as world and national food supply and distribution and economic and social development. Urbanization and industrialization, new types of employment and roles of women, their effects upon fertility and lactation - these and other questions form a large umbrella over the details of physiology and personal behavior such as have been discussed here. Although macro policies and decisions may determine whether specific steps are feasible or likely, this presentation has focused on the latter, the near points in our visual field, as more amenable to management and perhaps also as arguments for larger-scale attack.

References

1. Wishik, S. M., K-H. Chen, S. F. Klein and S. C. Scrimshaw. 1972. The definition and measurement of male fertility. Presented at the annual meeting of the Population Association of America, Toronto, Canada, April.

2. Siegel, E., and N. Morris. 1970. Epidemiology of human reproductive casualties, with emphasis on role of nutrition. In Maternal nutrition and the course of pregnancy. National Academy of Sciences, Washington, D. C., U. S. A.

3. National Center for Health Statistics. Infant mortality problems in Norway. Pub. Health Service Publ. No. 1000; Series 3, No. 8.

4. Jacobson, H. N. 1972. Age-specific pregnancy risk (manuscript). Presented to Subcommittee on Fertility and Nutrition of the Commission on International Nutrition Programs, National Academy of Sciences, Washington, D. C., U. S. A., March.

5. Pan American Health Organization. 1971. Inter-American investigation of mortality in childhood. Provisional report. PAHO, Washington, D. C., U. S. A., September.

6. Salber, E. J., M. Feinleib and B. MacMah
1966. The duration of postpartum amenorrh
Am. J. Epid. 82: 347-358.

7. Potter, R. G., M. L. New, J. B. Wyon and J. E. Gordon. 1965. Applications of field studies to research on physiology of human reproduction: lactation and its effects upon birth intervals in eleven Punjab villages, India. In Public health and population chang

M. C. Sheps and J. C. Ridley (eds.). University of Pittsburgh Press, Pittsburgh, Pa., U.S.A.

8. Latham, M.C. 1972. Effects of lactation on human fertility (manuscript). Presented to the Subcommittee on Nutrition and Fertility of the Commission on International Nutrition Programs, National Academy of Sciences, Washington, D.C., U.S.A., March.

9. Jelliffe, D.B., and E.F.P. Jelliffe. 1971. An overview: symposium on the uniqueness of human milk. Am. J. Clin. Nutr. 24:1013.

10. Rao, K.V., and C. Gopalan. 1969. Nutrition and family size. J. Nutr. Dietet. (India) 6: 258.

11. Venkatachalam, P.S. 1962. Study of diet, nutrition and health of the people of the Chimbu area, New Guinea highlands. Department of Public Health, Territories of Papua and New Guinea. Monograph No. 4.

12. Bailey, K.V. 1964. Synopsis of rural nutrition studies in Indonesia. Med. J. Australia 53, No. 1: 669.

13. Wray, J.D., and A. Aquirre. 1969. Protein-calorie malnutrition in Candelaria, Colombia. I. Prevalence; social and demographic factors. J. Trop. Pediat. 15, No. 3: 76-98.

14. Wyon, J.B., and J.E. Gordon. 1962. A long-term prospective field study of population dynamics in the Punjab, India. In Research in family planning, Clyde J. Kiser (ed.). Princeton University Press, pp. 17-32.

15. E. Quioque, Food and Nutrition Research Center, Philippines (manuscript).

16. Scrimshaw, N.S., C.E. Taylor and J.E. Gordon. Interactions of nutrition and infection. World Health Organization, Geneva, Switzerland. WHO Monograph Series No. 57.

17. Chopra, J.G., et al. 1970. Maternal nutrition and family planning. Am. J. Clin. Nutr. 23: 1043.

18. Pan American Health Organization. 1970. Maternal nutrition and family planning in the Americas. PAHO, Washington, D.C., U.S.A. Scientific Publication No. 204.

19. Taylor, C.E., and M.F. Hall. 1967. Health, population and economic development. Science, 11 August, p. 4.

20. Schultz, T.P. 1967. A family planning hypothesis: some empirical evidence from Puerto Rico (manuscript). Rand Corporation, December.

21. Rulison, M.V.F. 1970. Report on topical investigation and analysis of nutritional supplements in family planning programs in India and Pakistan (manuscript). Research Triangle Institute, October.

22. Wishik, S.M., et al. 1971. Estimation of fertility change in Pakistan by retrospective quasi-cohort analysis of group specific fertility patterns. Am. J. Public Health 61, No. 6: 1080.

23. Berg, A. 1972. Nutrition and the population dilemma(manuscript). March.

24. Oelhaf, R.C. 1971. Interaction between nutrition and family planning (manuscript). Prepared for the Office of Nutrition, US/AID, Washington, D.C., U.S.A.

25. Wishik, S.M. 1965. Community programs to modify family size: indication for organization and planning. In Public health and population change, M.C. Sheps and J.C. Ridley (eds.). University of Pittsburgh Press, Pittsburgh, Pa., U.S.A.

26. Taylor, H.C., B. Berelson, D.W. Helbig and K-H. Chen. 1970. Requirements for the extension of maternity care and family planning through countries of the developing world. Intern. J. Gynecology Obstetrics 8, No. 5, Part 2: 718-723.

27. Howard, L. Plan for 10-year study of integration of health and family planning programs (manuscript). US/AID, Washington,

D.C., U.S.A.

28. Stern, R. G., M. Guzman, S.M. Wishik and B. Pasquariella. Joint study on fertility aspects of nutrition survey data - INCAP and International Institute of Human Reproduction (in process). Columbia University, New York, N.Y., U.S.A.

29. Hodges, R.E. 1971. Nutrition and the pill. J. Am. Dietet. Assoc., September, p. 212.

30. Gonzalez, C. 1970. Continuous microdoses of chlormadinone during lactation. Ginec. Obstet., Mexico, 28: 563.

31. Chopra, J.G. 1972. Effect of steroid contraceptives on lactation (manuscript). Presented to the Subcommittee on Fertility and Nutrition of the Commission on International Nutrition Programs, National Academy of Sciences, Washington, D.C., U.S.A., March.

32. Zatuchni, G.I. (ed.). 1970. Postpartum family planning. Population Council, New York, N.Y., U.S.A.

33. Schlesinger, E.R., and N.C. Allaway. 1955. Trends in familial susceptibility to prenatal loss. Am. J. Public Health 45: 174.

PURCHASING POWER OF AFRICAN AND ASIAN CONSUMERS IN RELATION TO MEETING THE NUTRITIONAL NEEDS OF THE CHILD THROUGH COMMERCIAL CHANNELS*

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Low-income consumers are by necessity and tradition seldom in the position of devoting special interest to the proper feeding of infants and children. Food is usually not sufficient for the whole family and there may be priority orderings in the eating habits and lack of knowledge about the special needs of the children that lead to deficiencies in the child's diet. In looking for solutions to the nutrition problems of children there has been increasing emphasis on using the commercial system for distributing specially-processed children's foods. A number of such foods have appeared in South and Central America, Africa and Asia and experience seems to show that success is reached only with difficulty. A new, packaged and branded children's food has to be sold to consumers who are not in the habit of giving special foods to children or buying packaged products, and who sometimes have weak contacts with the commercial channels because of geography and climate. These needy consumers often have such low purchasing power that they cannot be expected to buy the new products in the recommended amounts and with sufficient frequency. Does this mean that there is no scope for formulated, commercially-distributed foods in combating the malnutrition of children in Africa and Asia? This question will be analyzed in the following paper.

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The general character of consumer demand

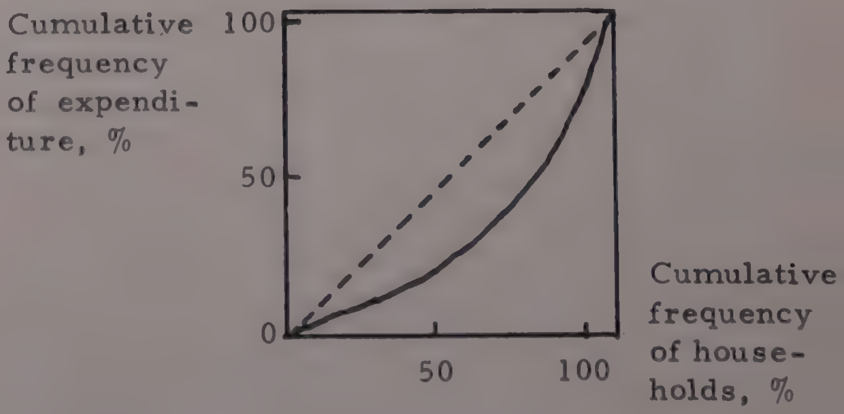
The behavior of a consumer market can often be explained by economic factors. The reactions of consumer demand, shown in purchases and consumption, is usually described in terms of various so-called elasticities of demand, such as income elasticity (relative consumption change which accompanies a relative income change), price elasticity (relative change in consumption of a product when its price changes), and cross elasticity (relative change in consumption of one product when the price of another changes). One can sometimes talk of the substitution between whole classes of consumption. If the price of food increases, clothing purchases may go down, etc.

Through the years there has been an immense documentation of the relationship between income, price, and demand, and it is usually found that the income elasticity for food is low (the so-called Engel's Law states that the relative proportion of income spent on food decreases as income increases) and that price elasticities vary with the kind of food. The latter is rather low for most basic foods, implying that a certain amount of food is bought regardless of price and that a price decrease usually does not lead to a corresponding increase in demand. If one knew price and income elasticities it would be possible to state what would happen to the nutritional situation of consumers if income changed and what price policies would be needed to direct consumption in a proper way. Unfortunately, income and price are based on aggregate statistics of whole groups of consumers in the form of either cross-sectional or time-series studies. We lack detailed investigations on the reactions of single consumption units to various market variables, such as temporary changes in incomes or prices, migration, changes in family size, introduction of new products in the market or educational campaigns. Until we have this knowledge we cannot effectively undertake marketing measures.

The distribution of purchasing power

When describing the economic status of consumers in a country the average national income *per capita* is usually given. This income is, however, often not reached by a majority of the consumers. In order to obtain a proper idea of the real status of purchasing power, one must use income distribution figures. Empirical data show that the distribution of purchasing power is quite skewed in most countries. As an example, the household expenditure data for Tunisia in 1964-65 are given in Figure 1. As can be seen from the figure, half of the population accounted for only about 20 per cent of the total household expenditure. The average yearly *per capita* expenditure was about 71 dinars (approximately $US 140), but some 70 per cent of the population had a *per capita* expenditure below 70 dinars (1). The case is similar in India, where according to the National Sample Survey 1963-64, the estimate of monthly total consumer expenditure *per capita* in rural areas was about 22 rupees (approximately $US 3) but where about 60 per cent of all households had a *per capita* expenditure below 21 rupees and about 25 per cent a *per capita* expenditure below 13 rupees (2).

FIGURE 1. EXPENDITURE DISTRIBUTION IN TUNISIA



The expenditure patterns vary with income, geographical and climatic conditions, cultural traditions, etc. In most low-income countries a major part of income is spent on food, sometimes in the form of so-called autoconsumption of products grown by the household itself. The consumption is usually concentrated on a few staples, often of the starchy type. There is an abundance of documentation on consumption patterns in different parts of Africa and Asia. As an example it can be mentioned that in India as a whole, 70 per cent of expenditure in rural areas and 60 per cent in urban areas was for food. The cereal component of the food was rather high, some 55 per cent in the rural and 37 per cent in the urban sector (3).

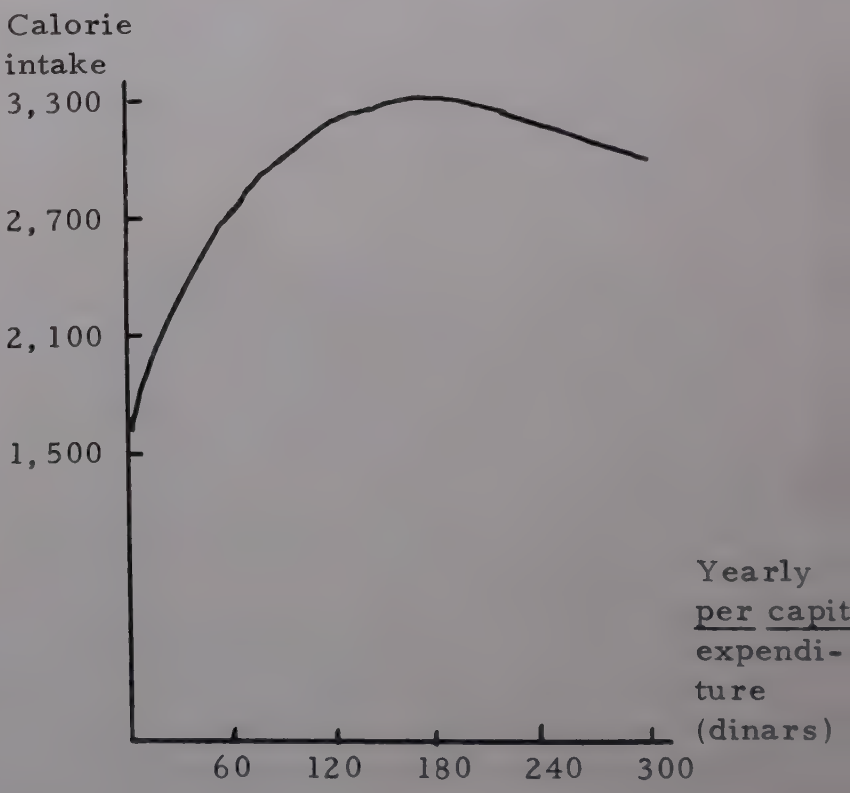
The importance of autoconsumption varies with agricultural practice. Common products for autoconsumption are milk, eggs, cereals, fruits and legumes. With urbanization, autoconsumption declines or disappears altogether and the households become totally dependent upon the commercial distribution system for their food supply. This might easily lead to a decline in nutritional status. Urbanization and increased incomes also often lead to higher consumption of imported foods (4).

Income as a determinant of nutritional status

With rising incomes consumers can spend more money on food and on better quality food. As can be seen from Figure 2, consumers with low expenditure levels have a low per capita calorie intake, which goes up very quickly with income and then levels off or even declines. At the very low levels, calorie consumption elasticity is high and a small increase in income produces a more than proportional increase in calorie consumption. At an expenditure level of over 40 dinars the elasticity will become lower and an income increase will produce a less than proportional increase in calorie consumption. Similar curves can be constructed for various types of foods, for protein intake and so on.

It is, however, especially important to find out the existing calorie and protein deficiencies among consumers of different ages and to what extent these can be related to income. That there is such a relationship can, for example, be seen in the data from Tunisia, which show that 48 per cent of the households with a per capita expenditure below 30 dinars ($US 60) per year had a per capita intake of less than the recommended level of 2,000 calories and 36 per cent of the same households were deficient in protein intake (less than 55 grams per day). Corresponding figures for households with a per capita expenditure surpassing 100 dinars ($US 200) per year were 2 per cent and 4 per cent (5). Depending on food habits and child feeding practices such deficiencies will be more or less severe on the children's nutritional situation.

FIGURE 2. RELATIONSHIP BETWEEN PER CAPITA EXPENDITURE LEVEL AND CALORIE INTAKE IN TUNISIA



Source: Reference 1, p. 421.

The importance of the commercial distribution system for nutrition

In many countries in Africa and Asia agriculture is the dominant occupation and much of what is produced never enters the market but is consumed on the farm. In these subsistence economies commercial distribution is of minor importance, but for urban consumer and for cash-crop farmers commercial distribution is the main source of supply. In all economies, however, there is some kind of trading, if only for salt, oil and spices in the open marketplace, and the households come into more or less frequent contact with differen types of vendors. With improved transportation and information the commercial distribution system will increase in significance to consumers. More and more products are coming within their reach, as can be seen from Table I. A few products, such as toilet soap and packaged tea, can be found in about 80 per cent of all rural retail outlets. The number of retailers also implies a good market coverage, with one retailer for about 270 people and almost three outlets for each village in India. In other parts of Asia and in Africa, the open markets may dominate, but one usually finds even in small market villages one or two retailers selling various kinds of manufactured products.

TABLE I. MARKET COVERAGE IN URBAN AND RURAL RETAIL SHOPS IN INDIA OF SELECTED PRODUCTS (7)

Product	Availability			
	Number of rural retail stores	Per cent of all rural retail stores *	Number of urban retail stores	Per cen of all urban retail stores *
Soap bar	440,000	30	272,000	48
Soap powder	220,000	15	235,000	42
Optical brightener	140,000	10	170,000	30
Toilet soap	1,150,000	79	400,000	70
Tooth brush	97,000	7	130,000	23
Hair oil	177,000	12	146,000	25
Shampoos	19,000	1	58,000	10
Food grain	1,050,000	72	280,000	49
Edible oil	1,020,000	70	270,000	48
Packaged tea	1,060,000	73	360,000	64
Biscuits	293,000	20	181,000	32
Instant food	12,000	1	36,000	6
Baby food	26,000	2	52,000	9
Jam	7,000	-	28,000	5

*Grocers, general stores, chemists, cooperative stores, panbidis (kiosks) and various other stores are included. Total number: rural 1,452,000; urban 566,000.

A study of a typical market village in Ethiopia with 11 small general retail stores and 7,000 visitors on a market day shows that the average shop carries a very small assortment and only about ten food items, the most common of of which are coffee, sugar, salt and wheat flour. There are about 700 sellers in the open market on a major market day, of which 70 per cent sell agricultural products, mostly grain, spices and coffee. Most of the market visitors both sell and buy in contact with the open market and the general stores (6). These two examples serve to show the existence of a widely dispersed network of commercial distribution with good market coverage of a few basic staple products. For many consumers this distribution system determines the nutritional intake when products and their prices are matched with consumer purchasing power. The commercial distribution is often passive and has neither the scope nor the experience to introduce new packaged and branded consumer products. To this should be added the difficulties in continuously reaching outlying consumer areas because of poor roads and insufficient transportation capacity.

The marketing system works within the basic framework of consumer income, available supplies, traditions and beliefs, purchasing habits and general price levels. Profound structural changes would probably have to be undertaken in a society to obtain any marked consumption effects in the form of redistribution of income and pricing of basic food products. However, commercial distribution may be of help in influencing availability and quality of various types of foods and the special products may affect the food distribution within the family and the frequency of food intake. In order to do this, the consumers' awareness of the relationship between food and health must be increased and they must be taught to recognize signs of incorrect nutrition among family members. As is usual in all programs for change, the process goes through three stages: awareness, attitude change and behavior change.

Granted a given purchasing power and given prices, what can be done through the commercial system? There are two main strategies: a) education and information; or b) new product programs. On the surface it seems quite simple and logical to change the family's food habits through various informational and educational means and to teach families to grow some nutritious foods in their own backyard or buy cheap staple foods within their economic reach and mix them according to some predetermined recipe into foods suitable for children. The other strategy, which has also been tried with varying amounts of success, involves the production of a special low-cost children's food (for example, a protein-rich supplementary food) and its distribution through commercial channels to the consumers. In both cases it will probably be easy to obtain awareness and maybe also attitude change, but behavior change should be brought about to a greater extent for a new food than for home-made food. Modern marketing could be of assistance in solving some of the nutritional problems in traditional societies by helping the consumers use their purchasing power in a more efficient way and by making the channels of distribution more effective. As was mentioned, this could be partially accomplished by the introduction of low-priced nutritious products for children. In doing this the contribution from modern marketing could be to introduce a new frame of mind, designated the "marketing concept", to look at the nutrition problems from the consumers' point of view in a total systems approach, and to adapt products, packages, brands, prices and messages to the needs and psychology of the consumers with the help of accepted marketing techniques. There are many cases where sins have been committed against these very basic rules. "Production-oriented" approaches have been used instead and the main interest focused on developing production techniques and product concepts unrelated to the consumers' basic beliefs.

If commercial channels are to be used at all in solving nutritional problems, especially of children, all the weapons in the arsenal of the commercial marketing man must be used:

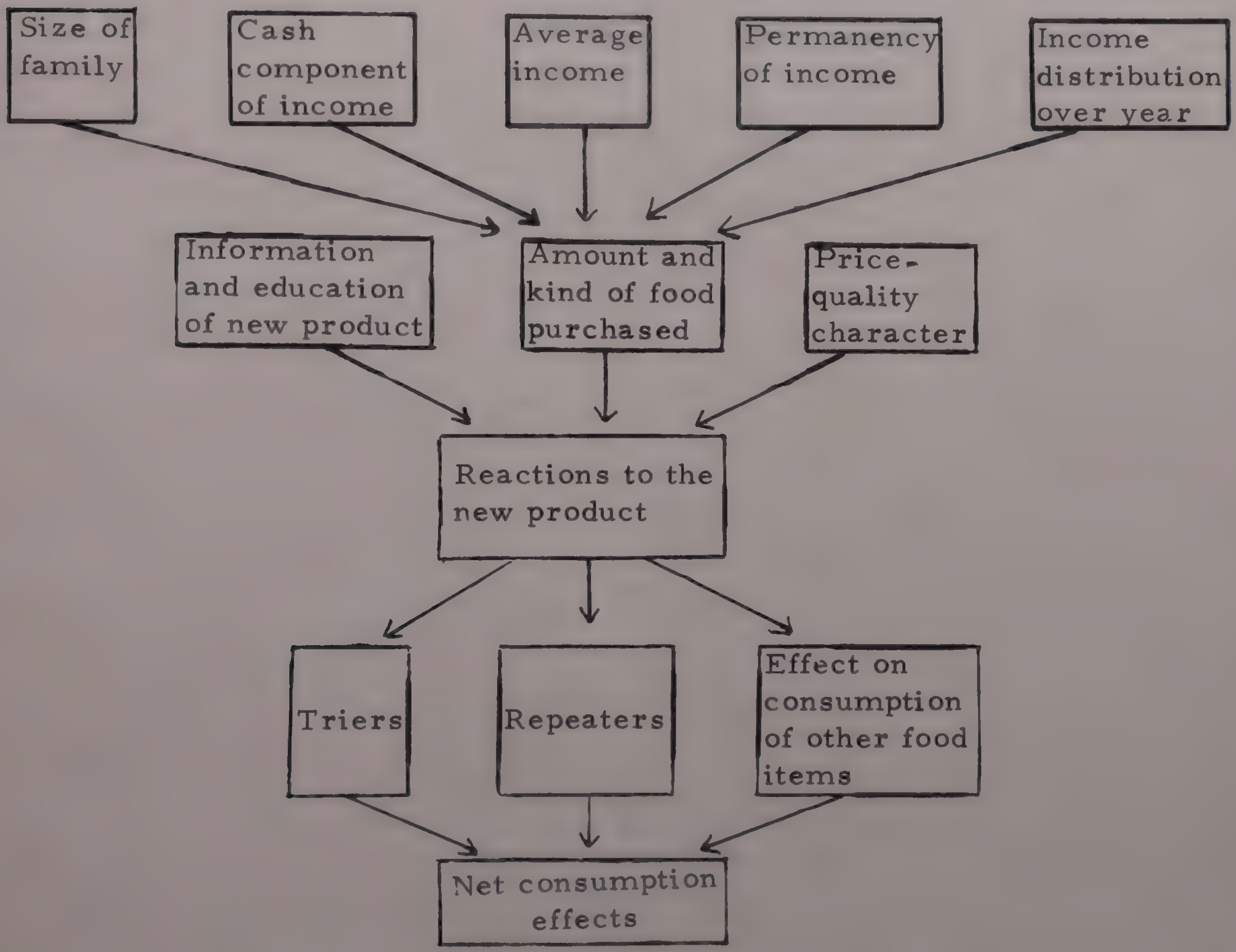
1. definition of goal variables (net nutritional changes, trial rates, repeater rates, market coverage, purchase and consumption frequency, etc.)
2. definition of target groups
3. differentiation of approaches according to market segments
4. establishment of proper marketing mix (price, package, information, personal selling, etc.)
5. choice of proper distribution channels
6. establishment of systems for market feedback information.

Purchasing power and nutritional effects of new food programs

In many new food programs it seems that purchasing power is the main limiting factor and in spite of all efforts to establish excellent marketing programs, implying segmentation of market, choice of proper channels and so on, the desired nutritional effects are not attained. The production volume may still be sold, but it does not reach the children in the target groups in such a way that nutritional improvement results. Since nutritional deficiency accompanies low purchasing power, the consumers who need the new products cannot afford them or cannot afford them in prescribed quantities and the consumers who can afford them may not need them. Therefore, careful precalculations of the relationship between total outlay for a new food and total yearly purchasing power of the target group must be undertaken before a new children's food is launched in full scale and the necessary consequences in the form of price subsidies, etc., considered. If this is not done the whole program may become a total waste and there may even be adverse consumption effects. An information system also has to be established to continuously follow purchasing and consumption.

Figure 3 shows some of the main variables that determine the net consumption effects of the introduction of a new children's food through a commercial system. As can be seen from the figure, the reactions to the new product are determined mainly by the initial

FIGURE 3. DERIVATION OF NET CONSUMPTION EFFECTS FROM THE INTRODUCTION OF A NEW CHILDREN'S FOOD IN THE COMMERCIAL MARKET


Size of family
Cash component of income
Average income
Permanency of income
Income distribution over year
Information and education of new product
Amount and kind of food purchased
Price-quality character
Reactions to the new product
Triers
Repeaters
Effect on consumption of other food items
Net consumption effects

purchasing pattern of the family. The size of income, its permanency and distribution over the year, together with available cash and number of family members to be supplied, comprise the setting to which the new product must be adapted. Depending on the success of the information and education regarding the new product (and of course its availability) and price and quality characteristics, consumers will try the new product and if they like it, continue to buy it. The frequency of purchase and consumption is a measure of the gross nutritional effects of the product. To obtain the net effects, however, we also must consider whether there are any other changes in consumption in the family and evaluate these. When purchasing power is limited, there is a risk that the introduction of a new product will influence purchases and consumption of other items in the family diet; the important question is, for better or for worse?

A study of the introduction of the Ethiopian supplementary children's food, Faffa, shows among other things, as can be seen from Tables II and III, that the permanency of income was a deciding factor for consumption of the product and that there were some substitution effects from the introduction of the product.

The need for commercially-distributed infant foods in the future consumption system in Africa and Asia

It has been said that business so far has not succeeded in overcoming malnutrition in less

TABLE II. CONSUMERS OF THE ETHIOPIAN SUPPLEMENTARY FOOD FAFFA IN VARIOUS EMPLOYMENT GROUPS AMONG FAMILIES WITH PRESCHOOL CHILDREN

Employment group	Permanency of income	Faffa consumers, %
Government employee	stable	51
Trade and service	semistable	46
Farmer, laborer, unemployed	unstable	37

Source: Tabulations from Faffa survey in Kaffa, May 1970 (unpublished tables). Ethiopian Nutrition Institute, Addis Ababa, Ethiopia.

TABLE III. SUBSTITUTION EFFECTS FROM INTRODUCTION OF THE ETHIOPIAN SUPPLEMENTARY FOOD FAFFA AMONG FAMILIES WITH PRESCHOOL CHILDREN

Occurrence of conscious exclusion of items from diet	Faffa consumers, %
One or more items excluded	54
No items excluded	14
No opinion	32
Total	100

Items excluded from diet, in cases stated	Faffa consumers, %
Animal products (cow's milk, butter, etc.)	37
Cereals ("adja", "teff", etc.)	25
Legumes (mainly fenugreek)	10
Breast milk	7
Bread (biscuits, injera, etc.)	2

Source: Tabulations from Faffa survey in Kaffa, May 1970 (unpublished tables). Ethiopian Nutrition Institute, Addis Ababa, Ethiopia.

developed countries through the introduction of manufactured low-cost foods (8). In most such new food programs, the maximum scale of operation averages about 1,000 tons a year, while the potential need would warrant volumes of 10,000 tons or 50,000 tons.

In order to forecast the future consumption situation in countries in Africa and Asia, assumptions must be made on changes in income, supplies, prices, consumers' occupations, degree of urbanization, etc. Some of the changes will tend to improve the nutritional situation, others may worsen it. Forecasts of supplies and demand are currently made (for example, in the indicative world plans), which on a macro level show the expected development. In the following paragraphs the more narrow aspects of changes in the commercial systems and their implications for the future distribution of manufactured low-cost foods are considered.

A much stronger struggle for space in the consumer's budget can be expected in the future from manufacturers of processed goods, both foods and nonfoods. The trend will probably imply an increasing number of manufactured products and more aggressive marketing from various domestic and foreign companies in the consumer markets. Each manufacturer will want to obtain an increasing coverage in the retail trade and the availability of various consumer goods will improve. This will result in an increasing assortment of goods placed at the consumer's disposal. The consum will then be tempted to reallocate his budget to obtain some of these new products, be they detergents or cosmetics, plastic containers, cigarettes, soft drinks or beer, transistor radios, ready-made garments, or, of course, high-priced, sophisticated baby foods. For some consumers, increasing purchasing power will allow for a more diversified consumption; for others there will only be more goods in the market to tempt them to use their money in new ways. As is prevalent in industrialized countries, for example in financing purchases and maintenance of automobiles, some of the money for the new products may come from savings on the food bill. This could then result in a deterioration of the nutritional situation; in some cases, even in spite of improved purchasing power.

If in the future there is no "cross fire" from processed nutritious foods in the battle for the consumers' money, the food proportion may lose out. When and if this will happen is difficult to predict. One thing is certain, however; society in the developing world is moving towards greater commercialization and national and multinational companies selling consumer goods will develop more efficient and advanced marketing techniques. Psychological factors may play a greater role in the consumption decision and products may be bought for status value rather than for their inherent qualitative properties. It will become increasingly difficult to change consumption and food habits through educational campaigns alone, since the alternatives competing for the consumers' money will multiply.

Against this background it is evident that in future the supply of commercially-distributed, low-cost nutritious foods must be stressed even more in order to maintain and improve the nutritional status of consumers. This will apply to the whole family, but even more to the children. Renewed efforts should be made to organize commercial marketing programs for the introduction of children's supplementary foods. Small-scale token projects are not enough; cooperation between industry, trade and government must take place. It should be possible to undertake operations of a size that will have a dramatic and lasting impact on the nutritional situation of the child.

References

1. Institut National de la Statistique. 1970. La consummation et les dépenses des ménages en Tunisie 1965-68. Etudes et enquêtes de l'I. N. S. Tunis. N1. 1, Décembre, pp. 25, 52, 291.

2. From Griffith, D. H. S. A review of family earnings, expenditures and consumption in selected countries of Southeast Asia. Undated stencil, pp. 22 and 28.

3. Ibid., p. 23.

4. See, for example, Dema, I. S., and A. P. den Hartog. 1969. Urbanization and dietary change in tropical Africa. The Food and Nutrition Bulletin of the Joint FAO/WHO/OAU-STRC Regional Food and Nutrition Commission for Africa, No. 7. Accra, Ghana, July, p. 31.

5. Reference 1, pp. 416 and 430.

6. Wickstrom, B. 1967. Sagure - a market village in Ethiopia. Addis Ababa, Ethiopia.

7. Special study undertaken on behalf of the Department of Family Planning, Government of India. Private communication from Mr. D. R. Gupta, Department of Family Planning.

8. Berg, A. 1972. Industry's struggle with world malnutrition. Harvard Business Review 50, No. 1, Jan.-Feb.

ENZYMES IN PROCESSING OF PROTEIN FOODS*

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The manufacture of foods has rapidly changed from an art to a highly specialized technology based on discoveries in the natural sciences. However, the transfer of scientific knowledge from microbiology and biochemistry into useful food technology has been rather slow. Art and tradition still play an important role in the fermentation industries and in various uses of enzymes in food processing. In recent years, the use of commercial enzymes has grown from an insignificant role to become an important aspect of food processing.

Since all living cells produce enzymes, they are obtainable from plant and animal tissues and from mcroorganisms. Although the quantities of enzymes produced on a commercial scale from plant and animal sources are very considerable, microbial enzymes have become increasingly important for both technical and economic reasons. Although certain plant enzymes have great industrial importance, large quantities of plant materials are required for the production of relatively small amounts of enzyme. Animal enzymes are by-products of the meat industry; thus, their supply is limited and other uses compete for the enzyme-yielding tissues. Microbial enzymes are not subject to any of the production and supply limitations of plant and animal enzymes. The development of production methods for microbial enzymes is potentially unlimited and, in addition, makes available enzyme systems which cannot readily be obtained from plant and animal sources.

Proteases are among the most essential of the digestive enzymes. Almost all living cells produce and use proteases for the hydrolysis of nutrient proteins to the amino acids which they need in their metabolism for producing cellular proteins and enzyme proteins.

Current major uses of proteases for the processing of various foods are summarized mainly to serve as a basis for the subsequent discussion of other possible applications of proteases for protein modification.

Papain, and to a lesser extent the other plant proteases bromelain and ficin, are used in the tenderizing of meat, in the chill-proofing of beer, and for the production of protein hydrolyzates. Fungal proteases are used mainly in the baking industry to modify wheat gluten; they are used to a lesser extent in meat tenderizing and in the production of protein hydrolyzates. Trypsin or pancreatin are used to some extent in the production of protein hydrolyzates. Rennin and some pepsin are used in cheesemaking for the precipitation of the casein curd. Bacterial proteases are used to a lesser extent in the production of protein hydrolyzates and in the chill-proofing of beer; they are also used to prevent gelation of concentrated fish solubles. All of these enzymes are used as digestive aids, an application which represents the borderline between food and pharmaceutical usage.

One should also include those applications where proteolysis is presently achieved by fermentation or by autolytic processes, such as the curing of cheese, the ageing of meat, or the production of oriental foods (soy sauce, miso, tempeh, and the fish sauce of Southeast Asia).

It is useful to consider the general criteria which govern the choice of a proteolytic enzyme for food applications. The specificity of the enzyme is of greatest importance in choosing a protease for use in food processing, but other considerations, such as optimum pH, heat stability, the presence of activators or inhibitors, price and availability affect the choice. In some instances, specificity seems to be the only consideration; for instance, the use of rennin for the formation of milk curds in cheesemaking. On the other hand, the production of protein hydrolyzates for flavor purposes requires enzymes of broad specificity which lead to extensive hydrolysis into low-molecular-weight peptides and amino acids.

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In the early days of enzymology, it was thought that proteolytic enzymes could hydrolyze any peptide linkage. This thinking developed because early investigators worked with rather crude enzyme preparations which often contained several peptidases. With the development of efficient and effective separation techniques, it has been possible to separate the several peptidases present in these crude preparations. When highly purified proteases were studied, it was discovered that these enzymes, like any other enzyme, are highly specific. Proteases from different sources will attack only the peptide linkages between certain amino acids. Therefore, when a protein is hydrolyzed by proteases from different sources, e.g. bromelain, bacterial proteases or fungal protease, the extent of hydrolysis and the hydrolysis products will vary with each enzyme. Also because of the specificity of proteases, none of the proteolytic enzyme preparations of commerce are able to completely hydrolyze a protein into its component amino acids. To a certain extent, this has limited the application of proteases. For example, when efforts have been made to prepare protein hydrolyzates from crude protein sources such as corn gluten by enzymatic hydrolysis, the resultant products have been unacceptable. Since it is not possible to completely hydrolyze such a protein enzymatically, polypeptide residues are formed, many of which have an extremely bitter taste.

Some attempts have been made to develop sources of proteases which are capable of hydrolyzing all of the peptide linkages in a protein. So far there has been only one such protease available; an intracellular enzyme produced by strains of Streptomyces griseus. This enzyme is a by-product of stremptomycin production. Following antibiotic production, the mycelium is separated, lysed, and the enzyme extracted and purified; it has been shown to be nonspecific since it is apparently capable of hydrolyzing all of the peptide linkages in a protein. It has been stated that this enzyme is capable of hydrolyzing a protein under normal conditions as thoroughly as acid hydrolysis of the same protein under conditions of high temperature and pressure for twenty-four hours. Although the enzyme has this very interesting capability, it has not been used commercially. The principal reason for this is that the enzyme yield is low and as a result the cost of the enzyme is high. This enzyme is sold under the name of Pronase*; it is marketed in the United States for about $10.00 per gram.

It has been learned that a protease produced extracellularly by a strain of Cephalasporium is also a nonspecific protease. This enzyme, however, is not available in any quantity.

A major problem in the food industry is that most research and development people have limited knowledge of enzymes and what they are capable of doing. Therefore, except for the classical food uses of enzymes, such as fruit juice clarification, syrup production, and flour modification, their use is seldom considered in solving a problem. This has been amply borne out in conversations with research people in the food industry; none of the individuals are doing any research and development. Areas where proteolytic enzymes could be used to modify vegetable proteins are discussed in the following paragraphs.

There are several protein beverage products being marketed or test-marketed throughout the world; most of them contain soy protein in relatively low concentrations (about 3 per cent). These products are supposed to supplement dietary protein intake, particularly in areas of the world where normal diets are deficient in protein, but with such a low level of protein, their value as a protein supplement is questionable. These low protein levels are due to the limited solubility of protein and without modifying the protein it is not possible to increase the concentration in beverage compositions. By means of enzymatic solubilization of vegetable proteins, it would be possible to increase the level of protein in beverages to an extent that they could then serve as worthwhile dietary supplements.

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*Registered trademark.

Particular care would have to be taken in selecting the proper enzyme to solubilize these vegetable proteins. Like all enzymes, proteases are very specific and as a result it is not possible to completely hydrolyze protein to amino acids with currently available proteolytic enzymes. When proteins are enzymatically hydrolyzed, peptides of varying chain length are produced. Some of these peptides have a bitter taste, which of course must be avoided in a bland-tasting product. This problem can be avoided in two ways. One method is to use a nonspecific protease such as Pronase*. This enzyme will hydrolyze all peptide bonds and as a result bitter-tasting peptides will not be formed. Unfortunately, nonspecific proteases are not available in commercial quantities or at economically feasible costs.

The other way to avoid the formation of bitter-tasting peptides is a short, controlled hydrolysis of vegetable proteins with commercially-available proteases such as bacterial protease. Peptide formation apparently increases with increasing hydrolysis time. Most proteolytic enzymes possess considerable endopeptidase activity, thus in a short period of time, some of the internal peptide bonds can be split. This will increase the solubility of the proteins without forming bitter peptides. It must be emphasized, however, that it will be necessary to control the enzymatic hydrolysis carefully and to inactivate the enzyme rapidly and thoroughly at the end of the reaction time.

It would appear that by enzymatic hydrolysis vegetable proteins can be solubilized sufficiently to prepare beverage products with protein concentrations of about 10 per cent.

A major drawback to the use of vegetable proteins, as far as Occidental tastes are concerned, is their "beany" taste. While it is possible to mask this taste in some products by the use of strong flavoring agents, it is not possible to do so in bland foods such as "synthetic" milks. Some Japanese work (1) has indicated that when soy protein is treated with a proteolytic enzyme, this "beany" taste is destroyed or eliminated. It has been claimed that by means of this enzymatic treatment it is possible to produce a bland-tasting soy protein that could compete with such products as sodium caseinate. If this is the case, a considerable economic advantage could accrue both to producers of the bland protein and to the users of such products. Currently, sodium caseinate is priced at about $0.50 per pound while soy protein costs about $0.08 per pound.

One of the production problems in producing food analogs from vegetable protein is obtaining uniform and complete dispersal of flavoring and coloring agents into the product. Producers of these food analogs are apparently not using enzymes to help solve this problem. However, it is speculated that by slight modifications of these vegetable proteins by either bacterial or fungal proteases, it would be possible to obtain better dispersal of flavoring and coloring agents into protein analog foods.

At the present time, commercial use is not being made of the proteins from grasses and leaves, except for animal foods. It would appear that these sources of proteins could be utilized as protein supplements and flavoring agents. The proteins in such sources could be selectively hydrolyzed and solubilized and then separated from insoluble fibers. While no such work apparently has been done it would be a relatively easy task to determine the feasibility of using such waste materials as grasses and leaves as a source of proteins.

Because of the nature of the substrates, i.e. relative insolubility, it would not be feasible to use insolubilized enzymes for the uses of proteases described above.

Cheese is a very old source of nourishment and is manufactured throughout the world by different techniques, largely based on local traditions. Common to all cheese varieties is the use of an enzyme preparation, rennin, which is added to the milk during the initial steps of the manufacturing process. Rennin coagulates casein, resulting in the formation of a gel or curd which is the first physical appearance of what later becomes cheese.

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*Registered trademark.

Rennin is extracted from the stomach of a calf; rennin denotes the pure milk-clotting enzyme, whereas calf rennet is the cruder stomach extract. In recent years, interest in enzyme preparations other than calf rennet has occurred because of frequent shortages resulting in elevated prices and price fluctuations in many countries. During the last few years, several rennet substitutes have been marketed in a number of countries. They have included
a) a 50/50 blend of rennet and pepsin; and
b) a microbial rennet derived from (i) Endothia parasitica, (ii) Mucor pusillus, and (iii) Bacillus cereus.

The number of microorganisms which secrete proteases is extraordinarily large. The specificity of these microbial proteases is in many cases broader than that of the well-characterized animal enzymes.

In the Orient, fungal and bacterial proteases are used in the production of particular foods which require the extensive hydrolysis of soy or fish proteins. In most instances these are fermentation processes, but the use of isolated enzymes (in contrast to the use of viable microorganisms) is under investigation and appears to be promising.

In a similar manner, the proteases of fungi play a vital role in the production of certain cheeses. Fermentation processes initiated by Penicillium roqueforti and P. camemberti are well-known examples. For all of these foods (soy protein, fish protein, casein) hydrolysis of the protein preserves the food and yields a condiment. The fish sauce of Southeast Asia, soy sauce, and cheeses have some common characteristics. They are protein foods in which carbohydrates are almost entirely absent; their proteins are largely or entirely hydrolyzed; and they are preserved, aside from the effect of protein hydrolysis, by the addition of large concentrations of salt. The possibility of replacing traditional fermentation methods for the preparation of these foods by the application of added enzyme preparations presents a challenge to the food technologist.

Unfortunately, a study of the application of enzymes in the processing of protein foods is capital intensive and highly sophisticated, requiring capital and a high level of technology or at least well-trained personnel.

There is no use in developing sophisticated techniques for eventual application in areas where there is no foreign-exchange capital to buy equipment and not enough trained personnel to run the plant. However, it is important to note that the amount of investment required is relatively small when compared to the potential nutritional benefits to be derived from a study of the application of enzymes in the processing of protein foods.

Reference

1. Fujimaki et al. 1968. Food Tech. 22: 339.

COCONUT PROTEIN TECHNOLOGY*

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The purpose of this report is to summarize and evaluate recent developments in the processing of coconuts for the recovery of food-grade protein products. Although this subject has been investigated quite extensively and intensively in a number of different research centers, extensive literature citations will not be included with this document. Those interested in details of past efforts are referred to a literature search prepared by the Tropical Products Institute of London or to FAO Document PL CNP/68/6 (1).

In many countries where there is a need, coconuts represent a significant source of potentially available food protein, even though on a world-wide basis there is considerably more protein available from other major oilseeds (2). Currently, world production of coconuts yields about 240 million kilograms of coconut protein annually. This protein has good nutritional value (1) and there is generally no concern about inherent toxic components.

Most of the coconuts are converted to copra to be used for the recovery of oil. The processes for making copra were not designed for the recovery of a food-grade protein. The repeated comments about molds, dirt and insect contamination in copra are testimony that processes generally do not accomplish by accident what they are not specifically designed to accomplish. Consequently, copra as presently produced cannot be looked upon as a source of food-grade protein.

In contemplating methods for processing coconuts for the recovery of food protein, it is necessary to bear in mind that for economic reasons the processes must recover the bulk of the available oil in marketable condition. In addition, certain constraints must be placed upon the operation to avoid either nutritional or organoleptic damage to the non-oil portions, particularly the protein.

In this document coconut processes will be considered in two categories: dry processing and wet processing. The characteristic feature of dry processing of coconuts for food is that the nuts be dried under sanitary conditions and the oil removed by pressing and/or hexane extraction. The resulting flour may be considered an end product or can be used as a raw material for the preparation of protein concentrates or isolates. In wet processing, on the other hand, the coconuts are ground fresh, extracted with water, the fibrous solids removed from the resulting slurry, and then the liquid centrifuged to produce oil and a low-fiber protein product.

Dry processing

The technology for drying coconut meats under sanitary conditions has been well developed by the desiccating industry. In cooperative work with one of the desiccators it has been demonstrated that coconut meats can be dried successfully with a minimum reduction in protein solubility. Unfortunately, this method of drying is relatively expensive, being estimated at about $US 7.00 per ton of husked coconuts. The Carver-Greenfield process has also been evaluated. No operating conditions have been found which could effectively dry the coconut meats without resulting in a substantial reduction in the solubility of the proteins.

A food-grade copra would be a much more economical raw material for the dry process. Two approaches that appear to offer the

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[*] Submitted as a background paper for the 20th PAG Meeting. PAG Document 2.9/9.

greatest promise at the present time include an inexpensive plastic heat tent, originated by and being tested by FAO, and the Subrahmanyan process (3). The latter process consists of dipping split coconuts into a protective solution (either dilute acid or alkali) followed by traditional sundrying. The quality of copra produced by either of these processes is distinctly superior to traditional copra. In spite of apparent technical feasibility, neither of these processes appear to be used to any significant degree, if at all. A thorough on-site investigation of each of these processes could be fruitful. Of particular importance would be quantitative data on the comparative losses to spoilage, rodents, etc., for traditional copra and for the FAO and Subrahmanyan copras.

Two companies in the Philippines are now manufacturing food-grade coconut flour for experimental and market development purposes. These are both made from desiccated coconut, one being an expeller flour and the other made by prepress solvent extraction. In both cases the operation of the expeller effects a reduction in the solubility of the protein. This does not reduce the nutritional quality and for many uses the lowered protein solubility represents no handicap. Desiccated coconut flour should be an acceptable ingredient in many types of formulated foods.

The oil content of dried coconut meats must be reduced by some mechanical means to make solvent extraction feasible and economical. Part of the oil can be removed from both desiccated coconut meats and food-grade copra in an expeller if the conditions are properly controlled. Under these conditions the cake will retain about 25% oil. The oil content can be reduced to less than 10% by filtration-extraction, provided the presscake has been conditioned by some suitable means, such as a roller mill. In bench-scale experiments to date, the flow of hexane in the filtration step has been only about 25% of the rate generally considered acceptable in commercial processing. Further work is needed to determine whether more practical flow rates can be achieved.

The motivation for producing a coconut flour containing soluble protein is to broaden the range of possible food applications for the products. In particular, such a flour could be used as the raw material for the preparation of a beverage base or protein isolates (4).

The estimated costs of producing flour and isolates by the dry process are highly dependent on the nature of the starting material. Based on information presently available, the estimates are:

Flour from desiccated coconut	7¢/lb
Flour from food-grade copra	3¢/lb
Isolate from desiccated coconut	50¢/lb

Wet processing

The major research and development efforts and technical accomplishments in the wet processing of coconuts for the recovery of food-grade protein have been made by the Central Food Technological and Research Institute in Mysore, India; the Tropical Products Institute in London and the Food Protein Research and Development Center of Texas A&M University. While each has made significant contributions to the ultimate success of the process, this document will discuss specifically the process as finally evolved at Texas A&M University. It is believed that the latter process is technically sound and yields products that should have food use potential at realistic prices.

The innovations which have led to the present process are as follows:

1. A two-step grinding, combined with multiple water washes, achieves at least 95% separation of oil from the fibrous residue at commercially practical rates of throughput.

2. Centrifugation of coconut milk at pH 7 to 8 rather than near the isoelectric pH results in about half as much oil remaining in the protein fraction and simplifies the recovery of oil from the cream.

3. Practical recovery of oil from the cream has been made possible by adding oil with appropriate agitation to invert the emulsion.

4. The focus of attention on utilization of whey components in a potential beverage base has resulted in: a) higher protein recovery in the primary product; b) more favorable economics; and c) elimination of pollution potential.

The wet process as developed at Texas A&M University (5) starts with shelling the coconuts to obtain shells, meats and coconut water. The shells are burned for fuel; the water is used in processing; and the meats are ground in two steps, the first step to reduce particle size and the second step to spill contents out of the cells. The ground meats are washed and pressed counter-currently, using coconut water as the washing liquid, to yield a milk and a fibrous residue. After pasteurization and adjustment of the pH to 7, the milk is centrifuged to yield an aqueous layer, an insoluble protein and a cream layer. The cream layer is demulsified by heating, addition of oil, severe agitation, and, finally, centrifugation to yield a high-quality coconut oil and more aqueous phase.

High-quality coconut oil is the primary product and is recovered in sufficient yield to make the rest of the process economic. The fibrous residue, insoluble protein fraction and the combined aqueous phases are dried separately and constitute the final products. These products are currently undergoing extensive chemical and physical analyses, looking particularly for functional properties and food use potential. No nutritional studies have yet been undertaken.

The principal protein food product (dried aqueous phase) is typically 25% protein (N x 6.25), 45% carbohydrate, 9% ash and 5% fat. It is anticipated that this product may have considerable potential as a beverage base. Because the major carbohydrate is sucrose, the product will be sweet with a pleasant coconut flavor. It is believed that the product could be positioned in the food industry (nutritionally) between milk and beverages containing only "empty" calories.

The insoluble protein fraction is 57% crude protein, 19% fat, 8% ash and 3% crude fiber. The fibrous residue is 23% crude fiber, 21% fat and 3% protein. One major food company has already indicated some interest in this latter product.

A preliminary economic analysis of the process indicates that the cost of producing the principal protein food product would be about 16¢ per pound if it were to bear the full cost of the process after taking credit for income from the oil. Any value that could be obtained from the insoluble protein fraction and the fibrous residue would reduce the cost of the primary product. Although the 16¢ per pound cost does not reflect the costs of advertising, distribution, sales and profits, the margin between this cost and the world price of nonfat dry milk would be expected to be rather attractive to food manufacturers.

Obviously, more investigations are needed to optimize the process and products. Unfortunately, many of the food properties, both favorable and unfavorable, of the several products will not be known until sufficiently large quantities can be made for distribution to food companies and nutritionists. Experiments to date have been limited to processing about 100-pound batches of coconut meats under rather unsanitary conditions. To improve upon this situation significantly, it will be necessary and has been recommended that a complete continuous pilot plant be constructed in a coconut-producing area so that adequate quantities of the products can be manufactured under good sanitary control for distribution to interested groups. In the meantime, efforts will go forward to characterize the products in the quantities and quality that are possible with the existing facilities.

References

1. FAO. 1968. Processing the coconut for human food. Document PL CNP/68/6. Food and Agriculture Organization of the United Nations, Rome, Italy.

2. Mattil, K. F. 1971. Oilseed meals: some general comments on their potential for food", In Amino acid fortification of protein foods, N. S. Scrimshaw and A. M. Altschul (eds.). MIT Press, Cambridge, Mass., U. S. A. and London, England.

3. Subrahmanyan et al. 1970. Coconut production. In The Subrahmanyan process of copra making. United Coconut Association of P. I. (UCAP).

4. Samson, A. S., R. N. Khaund, C. M. Cater, and K. F. Mattil. 1971. Extractability of coconut protein. J. Food Sci. 36: 725.

5. Hagenmaier, R., C. M. Cater, and K. F. Mattil. 1972. J. Am. Oil Chemists'Soc. 49:178.

Mexico City, Mexico

NINTH INTERNATIONAL NUTRITION CONGRESS

The Congress was held on 3-9 September, 1972, in the spacious and magnificent auditorium of the Medical Center and was attended by nearly 2000 delegates drawn from over 100 countries. The Congress was opened by President Echeverria of Mexico.

Besides the opening and closing plenary sessions, the program included 6 to 8 symposia each morning and 73 sessions for short communications. The symposia and the short communications were structured under four broad themes:

I. Today's basic knowledge
II. Prognosis for the undernourished surviving child
III. Foods for the expanding world
IV. Approaches to practical solutions.

The discussions on each were continued on all five days.

Some of the topics included under the theme "today's basic knowledge" were nutritional adaptation, metabolism of nutrients, parenteral nutrition, obesity, coronary heart disease and fatty liver. Recent observations on the role of trace elements in nutrition with special reference to their influence on cardiovascular function and metabolic processes were presented.

A wide spectrum of topics was covered under the second theme and papers were presented on metabolic and clinical aspects of malnutrition, nutrition, reproduction and pregnancy, maternal nutrition and effects on pregnancy, malabsorption, nutrition and lactation, infection and nutrition, nutrition and brain damage and growth and development.

The several sessions held under the general theme "food for the expanding world" highlighted the intensive efforts in progress for expanding the world food resources with regard to both quantity and quality. Increasing animal protein supply, efforts to improve quality and increase the quantity of plant proteins, production and use of novel proteins, fish protein, evaluation of nutritional quality, processing and nutritive value, food enrichment, additives and toxins were some of the topics on which papers were presented and reviewed.

"The approaches to practical solutions" dealt with the ecology of nutritional problems, nutritional assessment, food consumption surveys, nutrition education and training, planning and execution of comprehensive nutrition programs, infant feeding programs and evaluation of low-cost, protein-rich foods and included a large number of papers on nutrition extension work.

The program covered all the important aspects of the nutritional problems of today and was interesting to the delegates from both the developing and developed countries. The Proceedings of the Congress will be published in the summer of 1973 by S. Karger AG, Basel, Switzerland.

Aix-en-Provence, France

SYMPOSIUM ON SINGLE CELL PROTEIN (SCP)

An international symposium on SCP from hydrocarbons was held on 14-16 February 1972, under the Chairmanship of Professor H. Gounelle de Pontanel. Sixty-seven nutritionists, economists, toxicologists and animal husbandry specialists from fifteen countries and representatives of international agencies attended the meeting.

Eight major reports were introduced by American, Belgian, British, Dutch and French speakers and were followed by lively discussion. They dealt with perspectives and prospects of SCP, its nutritional value, toxicological aspects, food regulations, and use as food and feed.

The French Government (Interministerial and Interprofessional Commissions on animal feeding) has authorized the use of SCP grown on hydrocarbons in animal feeds providing both substrates and final products are kept under constant control. It was the general opinion of the symposium that carefully-controlled experiments in human feeding can now be initiated in well-equipped and well-staffed institutes.

The symposium included a visit to the British Petroleum plant in Lavera, which has an annual production capacity of 20,000 pounds (grown on gas oil) and which is expected to be operative this year.

The proceedings of the symposium will be published in French and English, by the "Centre de Recherches Foch", 4 Avenue de l'Observatoire, Paris 6é, France.

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RECENT SWEDISH DEVELOPMENTS ON PROTEIN CONCENTRATES

The following is a summary of recent research in Sweden. Further details may be obtained directly from the authors.

Fish protein concentrate*

One of the major problems in producing a cheap, edible fish protein concentrate is to get fresh fish in large quantities. A 25,000 - ton factory ship along with ten fishing trawlers,operating in the South Atlantic, enable most of the catch to be processed to ordinary fish meal on board the factory ship, leaving a part of the fish for use as raw material for FPC for human consumption. A preserved presscake is solvent-extracted and deodorized in a land-based factory at the fishing village of Bua on the west coast of Sweden. The fish protein concentrate has been used in cereals, bread, biscuits and pasta products with good acceptance. In these types of foods the lack of functional properties can be an advantage since the FPC does not change the normal texture and appearance of the products. A formula for an FPC-enriched bread, intended for the Swedish market, has been worked out and all nutritional and food technology data required for market introduction are available.

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* Bo Hallgren, Astra-Nutrition, Gothenburg.

Healthy Swedish children aged 4-6 months were given a formula in which milk protein was replaced by FPC. The formula was well accepted and there were no adverse intestinal reactions. Acceptability studies have also been performed with school children in Uppsala who were given a bun with and without fish protein as a between-meal snack. The fish protein product was well accepted and it was interesting to note that as many children preferred the somewhat greyish fish protein bun as preferred the white bun with milk protein.

A fish protein concentrate, intended mainly for enrichment of cereal mixtures, must be low in price, and the estimated price of FPC with a protein content of about 85 per cent is 79 US cents/kilo ex factory.

A method has also been developed for producing a fish protein with high functionality from fresh whole fish, e.g. herring. This protein is coagulable, whippable and has good water- and fat-binding capacity. It can be used in many products where other more expensive high-quality proteins are now used.

Whey protein concentrates for human consumption*

Relatively little attention has been paid to the dilute solution of protein in the whey which is obtained after the removal of casein from milk, as in cheesemaking. In the past, as well as today, most of the whey produced has been used as animal feed and that which could not be used in this way was discarded. However, the disposal of whey through the sewage system is now prohibited in many countries because of its high biological oxygen demand. Therefore, new methods to utilize whey constituents have been developed.

It seems likely that whey proteins will be utilized more efficiently for human consumption in the near future. Several methods to prepare whey protein concentrates are now being investigated; using methods such as gel filtration, ultrafiltration and dialysis it is possible to prepare whey protein concentrates with low lactose and salt contents.

The nutritive value of whey protein concentrates obtained by modern technology is very high. The PER and NPU values of these concentrates are higher than those of all other proteins except egg protein. Of special interest are the high contents of lysine, tryptophan,threonine and the sulfur-containing amino acids in the concentrates, which make them especially valuable as supplements to vegetable proteins of poor quality. The supplementary effect of whey protein concentrates in different cereals is now under investigation.

Whey protein concentrates could replace dried skim milk in weaning food preparations since the supplementary effect of whey is more pronounced than that of skim milk.

The concentrates have no unpleasent flavor or texture and are readily soluble; thus they could easily be incorporated into different dishes.

The relatively low phenylalanine content of the whey proteins makes them useful as a natural protein source in the dietary treatment of phenylketonuria.

Sunflower protein concentrates**

At present sunflower (Helianthus annuus L.) holds second place in international oil production and is the fourth largest source of oilseed protein in the world. The main part, about two-thirds of the world production, comes from Russia but considerable cultivation of this plant is carried out in Europe, South America and Africa. The main use of the plant is for the production of edible oil; subsidiary uses include direct selling and consumption of roasted dehulled kernels and the use of such kernels as nut substitutes in bakery and confectionery products. The seeds are also fed to poultry.

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** Gunnar Agren and Anders Eklund, Institute of Medical Chemistry, University of Uppsala.

Much interest has been directed to the potential use of sunflowerseed proteins in human food. So far, sunflowerseeds, unlike many other seeds, seem to be substantially free from toxic or antibiological factors. Biological tests with rats as well as *in vitro* experiments with sunflowerseed meal or aqueous extracts of sunflowerseed meal have indicated the presence of some trypsin inhibitor(s) in the seeds, but the biological effect of the inhibitor seems to be comparatively weak. However, other problems exist in the processing of these seeds. One is connected with the continuous methods for the extraction of oil used by the oilseed industry today, usually a combination of screwpressing and solvent extraction. Because of the high oil content of the sunflowerseeds, screwpressing cannot be used unless the husks are present. Consequently, the extraction residues left after screwpressing of the seeds contain a very high amount of crude fiber, which will limit its use in the food industry, especially in child feeding.

Another major problem is the high content of chlorogenic acid in the seeds. Under unsuitable processing conditions, e.g. alkaline pH, this polyphenolic compound will be oxidized to quinones and result in a product of a dark-brown to dark-green color. Since the quinones easily link covalently with various protein groups, this color is very difficult to remove. However, reducing agents such as sodium sulfite have proven useful in preventing the darkening process.

Some studies have been performed to determine the optimal conditions for the extraction of sunflower proteins from the defatted meal, but so far as is known, there are no commercial protein concentrates or isolates available except for some crude solvent-extracted meals. There is also a lack of knowledge on biological and other properties of sunflowerseed proteins.

The authors have prepared protein concentrate from sunflowerseeds by different techniques. One type was produced by a conventional solvent (hexane) extraction of dehusked seeds at 50°C. The crude protein content was 52% and the crude fiber content less than 4%. The flour had a bland, slightly nutty flavor and a white color. The protein efficiency ratio (PER) obtained for the flour fed as a porridge was of the order of 1.20-1.50, while the PER for porridge of heat-coagulated flour was about 1.65-1.90. The increase in PER after heat coagulation was considered to be due to the inactivation of a weak trypsin inhibitor.

This type of protein concentrate was also tested as a supplement to cereal-based diets for preschool children at the Children's Home of the Ethiopian Nutrition Institute, Addis Ababa. The supplemented diets were palatable, well-tolerated and nutritious as judged by weight curves.

A new technique was also developed to prepare lipid-rich protein concentrates ("lipoprotein concentrates") from oilseeds. The whole or dehusked seeds were extracted with aqueous ethanol and the protein concentrate was precipitated from the extract after heating. A lipoprotein concentrate was prepared from sunflowerseeds by this method. The concentrate contained 51% crude protein, 22% oil and 8% crude fiber. The caloric content was the same as that of full-fat soybean flour. Aqueous ethanol is known to be effective in color removal, but small amounts of oxidize polyphenols remained and gave a light-brown color to the lipoprotein concentrate. The PER of this concentrate was 1.65 and this value increased to about 2.5 after lysine supplementation.

Short-term toxicological studies were performed with male and female rats using the lipoprotein concentrates as the sole source of dietary protein at both 10% and 20% levels of protein. Extensive testicular degeneration occurred in almost all males fed the 10% protein diet containing 5mg α-tocopherol (vitamin E) per 100g. Animals fed the same type of diet containing three times this amount of vitamin E did not show any signs of testicular damage. The possibility of a vitamin E antagonistic effect by the protein concentrate should be considered.

The other observation was an increased appearance of lysosome-like bodies of often multivesicular character in the liver cell cytoplasm of rats fed these diets. This phenomenon had no relation to the dietary fat level but seemed to be more prominent when the sunflower lipoprotein concentrate was fed at a 10% protein level than at a 20% level. The physiological or toxicological significance of these findings remains obscure.

At the present time technical conditions for the hydraulic processing of dehusked seeds are being studied; it has been possible to remove 90% of the oil from sunflowerseeds by cold hydraulic pressing. The chemical composition, flavor and color of the protein concentrates prepared in this way are similar to properties of those prepared by hexane extraction, except for a higher oil content in the former (10-15% and 1-5%, respectively). The main advantages in using this technique are the absence of organic solvents and the low temperatures used during processing. Tests are being carried out to evaluate the biological properties of these products.

As in many other plant proteins, lysine is the first-limiting amino acid in sunflowerseed protein. Using the amino acid pattern of egg protein as a reference, the chemical score for lysine in different strains of sunflower varies but is generally about 50. A mutant strain of sunflower containing larger amounts of lysine in the seeds would probably increase the usefulness of this food protein to a large extent. Sunflower plant breeding has been carried out, particularly in Russia and France, primarily in order to obtain plants with higher oil yields and resistance to diseases and parasites. However, some systematic search for lysine-rich varieties has also been carried out. A linear negative correlation has been found between the lysine content of the seeds and the protein content; strains with a low seed-protein content contain more lysine per unit protein than protein-rich varieties. Up to now no particularly "lysine-rich" variety of sunflower has been reported.

The leaf protein project at the University of Lund[*]

A leaf protein project has been pursued for the last five years at the Institute of Plant Physiology, the University of Lund, supported by the Bank of Sweden Tercentenary Fund.

The project aims at the recommendation of suitable raw materials and processing methods for the production of protein concentrates without color, flavor or odor. The main product is intended for human consumption, but the effects of raw material and processing on fodder by-products, such as impure protein concentrates, cellulose residues and deproteinized juices, are also considered.

Selection of species giving high yields of extractable, high-quality protein. The project aims especially at the recommendation of potential new crops, and after preliminary examination of species from several plant families and orders, the investigation is now concentrating on *Centrospermae* species, such as *Amaranthus* (amaranth), *Atriplex* (saltbush) and *Chenopodium* (goosefoot, pigweed). The screening is done first in greenhouses and laboratories under standardized conditions. The yield of extractable leaf protein is determined, and the quality of the concentrate is described in terms of nitrogen content, digestibility *in vitro*, *Tetrahymena* relative nutritive value and methionine and lysine content. The methionine content is generally 2.0-2.2 per cent of the hydrolyzed protein and the lysine percentage is always far above the minimum value recommended by FAO.

The most promising species from the first screening will be examined in field trials, where the optimal fertilizer level, sowing time, row width, etc., will be determined. The preparation of protein concentrates on a pilot-plant scale will provide enough product for feeding trials with higher animals.

Climatic effects on some enzymes regulating protein metabolism are being studied after cultivation of the most interesting species in climate chambers.

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[*] Kerstin Lexander, Institute of Plant Physiology. Paper submitted as a background document for the 20th PAG Meeting. PAG Document 2.30/2.

The final species recommendation is intended to include both new crops and established ones, each cultivated during the optimal period of its growing season.

Recommendation of principles for production of decolorized protein concentrates. The project deals with two ways of obtaining decolorized precipitates: a) the utilization of only the soluble proteins not connected with chlorophyll and b) the preparation of a mixture of all or part of the membrane-bound, chlorophyll-connected proteins with the others and decolorization of the mixture.

The methods under a) include conventional separation of chlorophyll-containing proteins from white ones by heat coagulation in two steps. Large species differences in reactions to pH, temperature and time during this procedure have been found. The best separation gives only 35 per cent of the total coagulable protein as a white precipitate. However, after separation of the membrane-bound proteins from the soluble ones by centrifugation and column techniques, about 50 per cent of the proteins are recovered as white concentrates. Species differ very much in their behavior during centrifugation; the reasons for these differences during heat coagulation or centrifugation are being investigated.

Method b) implies that membrane-bound proteins are included in the concentrates. This means that the lower digestibility of these proteins as compared with the soluble ones decreases the overall digestibility. Therefore, the effects of size, structure and chemistry of different chloroplast residue fractions on their susceptibility to pepsin and pancreatin are being studied.

It is believed that by thorough knowledge of the species differences, not only in yield but also in reactions during processing, the best combination of raw material and technical principles can be determined.

INDIAN COUNCIL OF MEDICAL RESEARCH

The following are brief summaries of reports published in the Annual Report, 1972, of the National Institute of Nutrition, Hyderabad, India.

Induction of hepatic carcinoma with aflatoxin in the rhesus monkey

Aflatoxins are potential carcinogens but there are marked species variations in this respect. Although monkeys are known to develop severe aflatoxin-induced hepatic damage, there are no reports regarding aflatoxin-induced carcinogenesis in this species.

A large number of rhesus monkeys were used in this Institute more than eight years ago in a study where the hepatotoxic effects of aflatoxin were investigated. Of these, two monkeys, a male and a female, which had received small doses of the toxin had survived the 8-year period. Both animals had received 50 mcg of mixed aflatoxin (B_1 44%, G_1 44%, B_2 and G_2 12%) five days a week, intramuscularly, for one month. During the next 11 months they received 100 mcg daily. The route of administration was then changed to oral feeding; the male monkey received 200 mcg and the female 100 mcg daily for the next 4-1/2 years. The administration of the toxin was then stopped and the animals kept under observation. Two and a half years after the withdrawal of aflatoxin, the male monkey developed abdominal swelling, generalized edema and jaundice, and became severely ill. The animal was sacrificed and a complete autopsy performed. A single massive hard growth occupying the entire liver, with multiple small satellite nodules in the periphery, was seen. Microscopic examination revealed a hepatocellular carcinoma of the giant-cell type with marked pleomorphism and extensive infiltration.

The liver of the female monkey was found to be normal at laprotomy and a wedge biopsy was histologically normal. The animal is being observed.

Although the carcinogenic effect of aflatoxin has been seen in only one monkey, this finding is considered significant.

Varietal differences in aflatoxin production in food grains

Investigations carried out at the Institute show that among the seven varieties of maize tested, opaque-2 infected under laboratory conditions with the toxigenic strain of *A. flavus* produced markedly low toxin levels, while Deccan hybrid produced a maximum. Two other Indian varieties also produced relatively little toxin. The presence of a potent inhibitor in high concentration was shown to be present in a 5% sodium chloride extract using the opaque-2 variety. Earlier work from the same laboratory had shown the existence of varietal differences in peanuts and sorghums.

Effect of calorie supplementation on growth of preschool children

Diet surveys carried out in Andhra Pradesh State by the Institute have shown that the average daily intake of protein was 1.9g per kg body weight and calories, 725*.

The mean calorie deficit was approximately 300/day, and an investigation was undertaken to study the effects of providing about 300 calories daily through food supplements.

A total of 450 boys and girls belonging to the poor socioeconomic class, aged between 1 and 5 years, were studied. Three hundred received the food supplement, and the rest served as controls. Home diets of these children provided, on the average, 18g protein and 700 calories per day. The protein value (NDpCal%) of the diet was computed to be 6.4.

The supplement consisted of: wheat flour (23g), sugar (35g) and fat (10g) and provided approximately 310 calories and 3g protein. The total daily calorie and protein intakes were 1000 calories and 21g respectively. The NDpCal% of the daily diet including the supplement worked out to 5.2. The ingredients were cooked into a sweet ball and distributed to the children, who were assembled at a central place in the village to receive the supplement. It was ensured that all children consumed the food supplement completely and did not cut down on normal home diets. The supplementary feeding has been carried out for six months and is being continued. About 80-85% of children received the supplement for more than 75% of feeding days and only these children have been considered for the purpose of analysis of data.

The children who had received the supplement had significantly higher gains both in height and weight in all the age groups as compared to children who had not received the supplement. Results of clinical assessment showed that the prevalence of general signs of protein-calorie malnutrition in the supplemented group (1.4%) was lower than that in the control group (4.6%).

An outbreak of measles in the community during the study provided an opportunity to test the adequacy of normal levels of calorie and protein intakes for children exposed to infection. Within the first three months of starting supplementary feeding 82 children who were receiving food supplements and 32 not receiving supplements developed measles.

A comparison of the gains in height and weight of those children who had developed measles and those who had not in the supplemented and control groups, at the end of three months of the experiment, showed that gains in height and weight in the supplemented group with and without measles were not significantly different. Among the unsupplemented group, the gains in height and weight of children without measles were decidedly higher than those who had developed measles. Children with measles had actually lost body weight. Food supplements provided in this study were adequate enough to have a definite protective influence on the adverse effects of measles on the growth of children.

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*A Decade of Papers, National Institute of Nutrition, 1961-1971, p. 41.

The food supplements provided 310 calories, which met the calorie deficiency, but provided only 3g protein. The total protein intake was 21g/day (approximately 1.1g reference protein per kg body weight), which is only marginally higher than the normal requirement.

INTERNATIONAL DEVELOPMENT RESEARCH CENTRE (CANADA)

The following reports summarize a few recently committed projects of the Agriculture, Food and Nutrition Sciences section of IDRC.

Triticale research and development

$3,250,000 (over 5 years $2,500,000 to CIMMYT; $500,000 to the University of Manitoba; $250,000 unallocated).

The Canadian International Development Agency (CIDA) has allocated 3.25 million dollars to finance an expanded and accelerated program in triticale research and development, to be undertaken by the Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico City, in cooperation with Canadian research institutions, one of which is the University of Manitoba. The object of the cooperative project is to develop triticale varieties that will complement wheat, barley, rye and other cereal grains and to provide a new crop well-adapted to a wide variety of conditions and capable of substantially increasing food production in the developing countries.

The primary purpose of the breeding program will be to broaden the genetic base, to increase yield, disease resistance and environmental adaptability, and to develop practices to achieve these ends. Nutritional quality and the utility of this new man-made cereal are also of considerable concern.

Cassava/swine research project

$3,250,000 (over 5 years $2,500,000 to CIAT; $750,000 to Canadian research institutions, to be allocated).

CIDA has also allocated a sum of $3,250,000 to finance a cassava/swine research project at the Centro Internacional de Agricultura Tropical (CIAT), Cali, Colombia, and in a number of Canadian research institutions. The research program will endeavor to develop an agricultural technology which will substantially increase both the yield and protein content of cassava varieties; establish a world germ plasm collection; develop packages of agronomic practices best suited to the production of high-yielding cassava varieties of improved nutritional quality; develop systems of processing and preservatio applicable within small rural communities; and develop animal feedstuffs and feeding systems based essentially upon cassava products.

Cooperative research activities are being established between CIAT and some agricultural research institutions in cassava-growing regions. A substantial training program is also envisaged at CIAT for agricultural scientists and technologists from countries which will eventually benefit from the results of this research program.

Multiple cropping (the Philippines)

International Rice Research Institute (IRRI), Los Banos, the Philippines; $230,800 (over 2 years).

A grant has been made to IRRI to support further research on the growing of crops such as soybeans, sweet corn, sorghum, potatoes and other vegetables, in combination with rice. Research will be undertaken to develop improved production technologies for different multiple cropping systems, both at IRRI and among the rural communities;to obtain more precise information regarding the economics of different cropping systems and the marketing potential of different kinds of farm produce; to demonstrate the benefits of multiple cropping to encourage its adoption; and to train scientists and agricultural specialists to carry out multiple cropping in their own countries.

This project is essentially a pilot project, combining research at IRRI and at the University of the Philippines College of Agriculture, with a view to further work on this aspect of agricultural research. IRRI and UPCA are both making substantial contributions to the overall project in supplies and equipment, personnel and financial assistance.

Grain legumes (Caribbean)

The University of the West Indies, Kingston, Jamaica; $186,425 (over 2-1/2 years).

A grant to the University of the West Indies to assist the Faculty of Agriculture in carrying out research on two crops, pigeon peas and dry beans, each of which has considerable economic and nutritional importance in the Caribbean and many other regions. The project will consist of the breeding of pigeon peas over a range of latitudinal and rainfall conditions in the Caribbean; the coordination and exchange of breeding material among workers in Puerto Rico, Guadeloupe, the Dominican Republic, Makerere University, Uganda, and a proposed new crop institute in Hyderabad, India; the development of a plant-breeding program from findings gathered from several breeding centers; and the breeding of dry beans and maintainence of close contact with other dry-bean projects in Latin America and Uganda.

A substantial part of the budget will go for the training of graduate assistants. The University's contribution to the overall project will be approximately $155,200.

Grain milling and utilization (West Africa)

The Government of Nigeria, Department of Agriculture; $132,250 (over 2 years).

The grant to the Government of Nigeria, Department of Agriculture, is to assist in a project to develop improved rural milling systems by utilizing a successfully-tested milling system developed in Canada.

The project embodies a total systems study of the grains and grain legumes produced, stored, marketed and distributed within a rural region of Nigeria. It is linked with another project in which the products of the mill, together with starch and flour from cassava and other root crops, will be developed into a variety of cereal products including infant foods, which will be test-marketed among low-income groups.

With this mill, there is a distinct possibility of producting inexpensive high-protein foods, and developing new, simple, rural technologies which can be demonstrated and repeated across the entire zone of Africa south of the Sahara and through many parts of Southeast Asia.

The Government of Nigeria is contributing a total of approximately $66,000 to the project in salaries, research expenses, land and buildings.

WAITRO SURVEY

The World Association of Industrial and Technological Research Organizations (WAITRO) recently conducted a survey by means of a comprehensive questionnaire to determine the main needs of industrial research institutes in developing countries. The report was compiled on the basis of replies from 28 of 44 technical members of WAITRO in many developing countries.

The highest priority of needs was given to industrial training of technical personnel and to training in industrial application of research and development results. Next in importance came industrial exploitation of research and development results. In decreasing priority thereafter were needs for financing of equipment, financing the training of personnel, financing research projects, dissemination of technical "know-how", promoting research programs, sources of technical information, library services, evaluation of research and planning of research.

It should be noted that WAITRO came into existence in 1970 at the instigation of the United Nations Industrial Development Organization (UNIDO). The history of this development and the activities being planned by the organization appear in UNIDO Industria Development News, Vol. VI, No. 1, 1972.

The complete report, titled "WAITRO: Priority of Needs of Industrial Research Institutions in Developing Countries", may be obtained from Dr. P. C. Trussell, Secretary-General, WAITRO, 3650 Westbroo Crescent, Vancouver 167, B.C., Canada.

PROJECT POSHAK (INSTANT CSM PILOT STUDY), MADHYA PRADESH, INDIA[*]

The primary objective of this two-year pilot project funded by the Government of India, the State Government of Madhya Pradesh, US/AID and UNICEF is to evaluate the feasibility of "take-home" distribution of precooked commodities such as CSM (corn-soy-milk blended food product) for children up to three years old and pregnant and lactating women. CARE/India is working closely with the local authorities in carrying out this project.

Phase I of the project, covering seven districts, is estimated to reach 3,614 mothers and 14,460 children who will receive 200g and 100g, respectively, of the sweetened blended food product. The food distribution will be weekly over a period of six months and the program as a whole will be combined with a health and family planning network in order to provide total family health care.

Phase II, which runs concurrently with Phase I, covers four districts and involves 400 mother 1,000 children and a similar control group. It will help to study the manner of food distributi at home, the value and utility of a precooked food, attitude of the mothers and other elders in the family and the nutritional status of the beneficiaries.

Phase III, covering only one district with 120 mothers, 480 children and a similar control group, will offer opportunities for detailed assessment of nutritional differences between the two groups. This phase of the program wi take one year to complete.

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[*] Outline of the Instant CSM Pilot Study, Madhya Pradesh, 1972. Stencilled report.

Project Poshak is expected to yield results of great significance to child feeding programs in providing techniques for reaching the most vulnerable groups, those between 6 months and 3 years.

V. F. Amann, D. G. R. Belshaw and J. P. Stanfield (eds.):

NUTRITION AND FOOD IN AN AFRICAN ECONOMY

An interdisciplinary conference to review all data accumulated in the field of nutrition, health, agriculture, economics and sociology relevant to the problem of infantile malnutrition was held in 1967. These two volumes are based largely upon the ideas and information exchanged at that conference and include several papers written later to fill in gaps which were not covered at the conference. According to the editors "it is intended that the resulting inventory of knowledge in food and nutrition should serve as a bench mark of information both for researchers when planning new research or evaluating the contribution to knowledge of others' completed research and for government administrators in the agricultural and medical fields when making policy decisions on food supply and nutritional matters".

The material is presented in six sections. The first concerns the ecology of malnutrition in Uganda, the second contains articles on food requirements and food consumption in Uganda an the third deals with food production performance and future potential. The fourth and fifth sections describe practical projects aimed at improving nutrition in the community. The final section, contained in Vol. II, is a bibliography on human nutrition and food supply in Uganda.

Amann, V.F., D.G.R. Belshaw and J.P. Stanfield (eds). 1972. Nutrition and food in an African economy, Volumes 1 and 2. Makerere University, Kampala, Uganda. Vol. 1 + Vol. 2, 581 pp.

J. R. K. Robson (ed.):

ECOLOGY OF FOOD AND NUTRITION: AN INTERNATIONAL JOURNAL

According to the publishers this is a new international journal of the nutritional sciences with a broad scope and wide content.

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THE EDWARD M. RYAN PRIZE

This prize will be awarded for operationally-oriented research directed toward the solution of malnutrition problems in low-income countries.

The prize, in the amount of $10,000, has been established through a grant to the James and Rachel Levinson Foundation of Pittsburgh. It will be awarded in late 1973.

For further information write to:

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